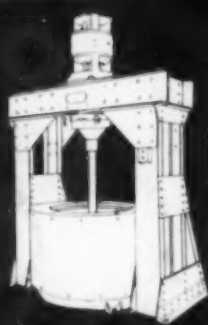


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Honors for the Business Press

Signal honors have lately come to the publishers of *Chem. & Met.* On February 17 the Edward W. Bok gold medal of the Harvard Advertising Awards was conferred upon James H. McGraw for "distinguished personal service rendered American commerce and industry through raising the standards of advertising."

In the annual editorial competitions of the Associated Business Papers, *Electric Railway Journal* was awarded a first prize for outstanding service to its industry. A prize-winning editorial, "No More Panaceas," brought to its writer, Sydney A. Hale, managing editor of *Coal Age* an award of \$500. In two other competitions honorable mention was given an editorial and an article appearing in *Engineering News-Record*.

Honors thus conferred are a stimulant to the entire business press—an incentive to make our papers still more effective tools of American business. To this end *Chem. & Met.* pledges its best effort in serving the chemical engineering industries.

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International Chemical Bargaining

WHEN Senator Copeland recently told the United States Senate that what the chemical industry of this country needs is a combination of German "know how" and American capital, he was merely fanning a flame of popular misconception. We do not know how many of his auditors were able to follow him over the tortuous routes by which he arrived at this one solution for such problems as over-production and unemployment, foreign trade and the national defense. Frankly, we could not. His picture of a weak and helpless industry cowering behind the high walls of a protective tariff hurt our pride more than his fallacious arguments challenged our logic. In marked contrast, however, was the clear-cut reasoning of the foreign representatives of the Department of Commerce, whose views, strangely enough, were cited by the New York Senator in support of his own curious contentions.

INTERNATIONAL agreements are by no means new, even in chemical industry. A number were in effect before the World War and since then have been quietly renewed, while others have been executed without attracting more than passing attention. It is only the popular flare for the sensational that has made front-page news of a threatened world cartel, dominated by an all-powerful German industry.

TOO many have assumed that the sole objective of the European alignment is to capture American commerce at home and abroad. Little thought has been given to the fact that American chemical industry, because of its present size and strength, its grasp of markets and its technical progress, has come to occupy a strategic position in world affairs. Instead of being crushed by a foreign giant many of our firms are in a position to dictate terms of international agreements to the lasting credit of American industry. No evidence of German dominance has yet appeared in the Standard Oil - I. G. agreement or the

foreign arrangements made by such concerns as the Bakelite Corporation, National Lead Company, General Motors or duPont. American business men are generally able to take their own parts and there is no reason to believe that the wool is going to be pulled over their eyes in any international negotiations.

DEPARTMENT of Commerce representatives at last month's conference of chemical executives made it apparent that the leaders of the German and French industries are earnestly seeking American participation in the international cartels. The view is commonly held that without this participation the cartels will fail to achieve their ultimate objectives, viz., a stabilized world industry and the elimination of costly duplications, over-production and disastrous competition. In other words, the advantages that can come to both the consumer and the producer through orderly production and distribution of chemicals on a world scale cannot be attained without the co-operation of a substantial portion of the American industry. To argue that this association is impossible under our anti-trust laws is to disregard what has already proved a logical and legitimate avenue for growth and development.

JUDGING from the conciliatory attitude of the leaders of the European industry, the next few months promise to be a period of intensified negotiation with American chemical manufacturers. In this international bargaining our stock in trade is just as impressive as that of the foreigner. Pyroxylin lacquers, butanol, ethylene glycol, isopropyl and amyl alcohols and electric-furnace phosphoric acid are but a few American developments of world-wide interest. In paving the way for American penetration into world chemical industry the Yankee trader again has an opportunity to demonstrate his shrewdness on an international scale.

Distribution Cost Surveys Should Become Fashionable

SEVENTY-THREE per cent of the business executives who have written to the Department of Commerce, regarding means taken to increase manufacturing companies' profits, report that their organizations are making vigorous effort to reduce manufacturing costs. This is a commendable situation, although one wonders what the other twenty-seven per cent are doing about this matter. But one is even more startled by the replies with respect to the reduction of distribution costs, because only twenty-nine per cent of the replies indicate that serious effort is being made to reduce the expense incident to marketing and distribution of manufactured commodities.

These figures are in themselves ample proof of the importance of the effort being made by the Department of Commerce and the Chamber of Commerce of the United States in the study and betterment of distribution conditions. The chemical engineering industries are no exception to the general rule that the greatest potential savings today are in the field of marketing. At the recent Washington conference of chemical executives, some of the most timely and interesting recommendations were those made by Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce, whose paper on this subject is published on pages 168 and 169 of this issue. It was he who pointed out the figures above quoted, and it was he who emphasized most strongly the urgency of selling efficiently and distributing in the most profitable market.

There are probably very few chemical executives who are guilty of as serious offense against good business methods as was the textile company that spent one dollar and twenty cents in selling expenses for every dollar's worth of textiles sold in a certain state. But there are undoubtedly many cases where a breakdown of selling costs into the appropriate parts would show that certain territory is being worked unprofitably and that certain selling methods are being used merely because of custom rather than because they bring dividend-making results. One cannot safely generalize for the industries on so complicated a matter, but it is safe to insist that only with critical cost studies will efficient distribution be possible. Accurate costs are quite as important in this field as in the plant or factory.

Selling Industrial Gas As A Chemical Engineer's Career

ALMOST any industrial process calling for heat is a possible application for fuel gas. Already there are over 21,000 industrial operations using gas fuel, and the field for expansion is practically unlimited. Every chemical engineering industry already uses gas heating in at least one application. And the situation is the same in the metal, textile and other fields.

The one common characteristic of all these applications is their unfailing diversity. Not only does each type of equipment to which gas heat is applied call for an individual engineering study, but almost every single piece of a given type of equipment calls for such a study. This is because of the almost endless variety of influencing conditions that can surround any given type of applica-

tion. The salesman of industrial gas for process heating must literally be able to absorb and digest in a few days all of the information about a plant and its processes that the operating engineers have acquired in years of study and experiment.

It is because of this necessity for becoming quickly familiar with a great variety of industries, that the general manager of a large gas company recently declared that chemical engineers made his best salesmen of industrial gas heat. Thoroughly trained in basic engineering and in the application of processes through a wide range of industries, the chemical engineer has proved to be able to familiarize himself with new sets of conditions more quickly than engineers trained in other branches. Considering this fact, together with the possibilities for growth and advancement that the field presents, it would seem to be worthwhile for recently graduated chemical engineers to investigate industrial gas selling as a possible career.

Hazards of Misquotation

IF A MAN presents a paper before a scientific society or publishes an article in a responsible technical journal, what assurance can he have that his remarks will not be misquoted and otherwise used to further the selfish ends of the unscrupulous promoter? This is not a mere academic question. It is an every-day problem in the publishing business and lately at least one of the engineering societies has been giving some thought to its practical solution. It is held that unless some adequate protection is assured the engineer who contributes to the literature of his profession, many are going to hesitate to discuss technical subjects of present-day commercial importance.

A case in point occurred at the recent meeting of the A.I.M.E. in New York City. Luis de Florez, consulting engineer, had presented a paper last December before the American Petroleum Institute in which he drew some comparisons between liquid and vapor-phase cracking. In a statement before the Petroleum Division of A.I.M.E. Mr. de Florez declared that entirely without his authorization "a publication styled 'Cracking' issued by the Public Relations Department of the Petroleum Conversion Corporation" had used portions of his paper in the furtherance of the so-called Knox cracking process. The isolated extracts quoted did not carry the author's true meaning unless they were read in connection with the context of his paper. Mr. de Florez, therefore, asked to have it recorded that he did not indorse the process in question and that the use of his name was wholly unauthorized. His protest was given the unanimous approval of the Petroleum Division, which in a formal motion gave its support to an effort to stamp out this malpractice.

Desirable as public condemnation is in such cases probably the surer remedy lies in the courts. A man has a certain property right in the use of his name and in the disposition of an article to which his name is signed. If the latter is used against his will and for ulterior purpose, he has cause for seeking legal redress. In taking such action the engineer will have the support of the responsible publisher as well as that of the engineering society interested in protecting the professional standing of its members.

The Hunger-Stricken Twenty-Eight Per Cent

WHETHER or not our British friends are endowed with a sense of humor has always appeared a slightly academic question. However, one suspects or hopes, at least, that the Britisher was having his little joke when he pointed out to us that better than a quarter of our benedicts are threatened with famine or worse in the event of a failure of the tin supply.

We quote in part from the *New York World* in a published interview with the English tin producer, Lord Askwith: "It has been estimated that if anything happened to America's tin supplies, about twenty-eight per cent of American husbands would go hungry, for the simple reason that tinned food has robbed American women of their culinary art."

The statement is open to debate. Granting the truth of the figures, it must nevertheless be maintained, in national pride, that something would doubtless be done about it by American wives. Further, upholding chemical industry, *Chem. & Met.* doubts that such a contingency would make more than a flutter so far as canned comestibles are concerned. The eminent lord has doubtless forgotten one of the notable signs of the times—inter-industry competition. Even now, organic coating materials have commenced their relentless march toward tin's markets in this field. It is an unsporting gamble to hazard that ten years will so change the complexion of this industry that even tin in solder will have become *déclassé* for canning purposes.

A Belated Memorial to Scientific Achievement

THAT the passing of the fiftieth anniversary commemorating the publishing of the first and greatest part of the work of J. Willard Gibbs on the equilibrium of heterogeneous substances should have gone almost unnoticed in this country is deplored by Dr. John Johnston, writing in the *Yale Scientific Magazine*. Not only was there a regrettable absence of proper recognition of the occasion by the own countrymen of this greatest of American mathematical physicists, but remembrance that commemoration was due must needs be brought home to us by those who could not own him, except as every true scientist belongs to the world at large.

It has remained for the chemical journal, *Chemisch Weekblad*, published in Holland, to take the initiative with a Gibbs number of that paper. As always, it is again the case that appreciation for Gibbs has had its inception abroad. Even at Yale, where he held the chair of Mathematical Physics for thirty-two years, and where all of his most important work was done, the one material evidence of the certain reverence which is felt for the great teacher is a bas-relief, the gift of Professor Nernst of the University of Berlin. It is to be hoped that present plans for the establishment of a professorship in Gibbs' name will be carried out at Yale and that nothing will longer delay publication of his complete papers, many of which are now out of print.

Further, it seems more than appropriate that Yale should not stand alone in material appreciation for the man and his works. Let it be remembered that it was Gibbs who, in large part, built the foundations of our physical chemistry, that his work forms the basis of much that is indispensable to the success of every great

chemical engineering industry, and that what order has been brought out of the chaos of our diverse chemical knowledge, we owe in large measure to him. It is fitting that the various associations of men who have benefited through his teachings should join with Yale in the provision of some enduring monument which will match in permanency Gibbs' gifts to scientific experience.

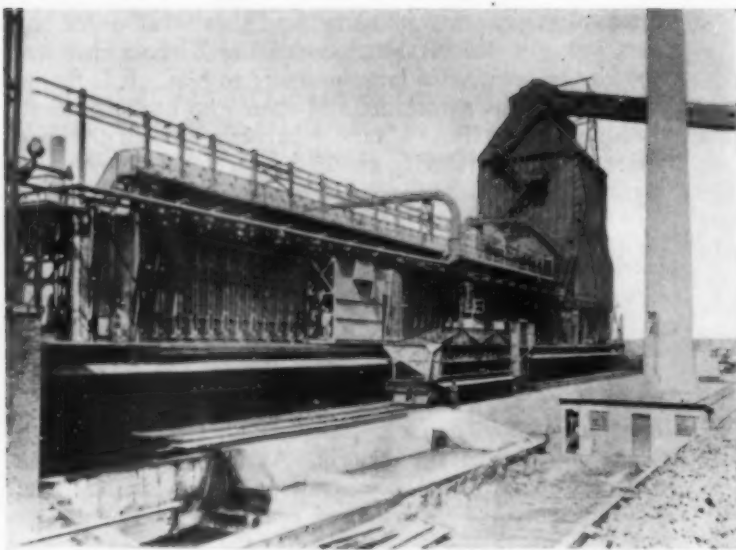
Dangers in Dust

MOST of us find it difficult to take the life insurance agent's warning very seriously. "You may be next," says he; but even as we nod assent to that undeniable possibility, our optimistic egos reassure us with the remoteness of the chance. As with individuals, so with industries. Probably no thought was farther from the minds of the owners and operators of the unfortunate plants than the possibility of the fatal and devastating dust explosions described in this issue by D. J. Price, of the U. S. Bureau of Chemistry. This natural reluctance to visualize oneself as the victim can be reduced only by patiently pointing out the danger, and by disseminating authentic information concerning the causes of such disasters. That efforts in this direction are fruitful is testified by the recent adoption of standard codes for the prevention of dust explosions in grain elevators and flour and feed mills by the American Engineering Standards Committee, an action which must be attributed largely to the investigations and educational efforts made by the Bureau of Chemistry.

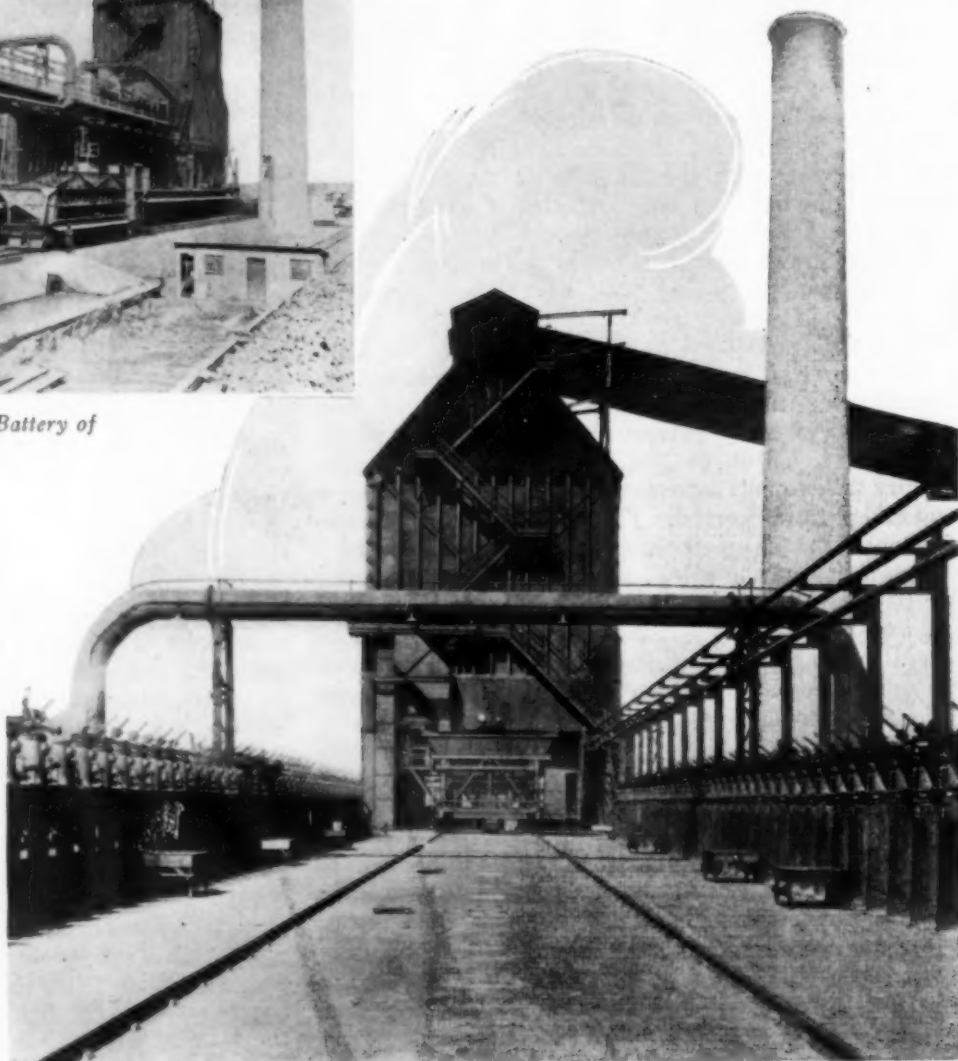
The same blithe confidence in our own security is the factor which makes a disaster necessary in order to bring home a lesson. Thus, apparently no one had considered coal-tar pitch a dangerous substance to handle until on Jan. 14, 1927, a dust explosion destroyed the French barque *Richelieu* which was being loaded with the material by mechanical loading trimmers with open motors, while open flame torches were used for light by the stevedores. The circumstances surrounding this explosion were called to mind by the recent decision of the U. S. District Court for Maryland in favor of the F. J. Lewis Manufacturing Company, producers of coal-tar products, and defendant in the suit brought by the Baltimore and Ohio Railroad which hauled the pitch to tide water and loaded the ship. The Court ruled that the manufacturer was not liable, since he exercised no supervision over the loading, had no knowledge of the nature of the trimmers used, and since, apparently, no one had previously considered pitch a dangerous substance to handle by the same methods used for coal. The eminent experts for all parties in the case, however, established the fact that pitch dust is apt to explode when brought in contact with open flames or exposed electrical contacts, the great danger from the latter being due to arcing caused by the congealing of pitch thereon.

In view of such unforeseen catastrophes, it seems not amiss to sound the "you may be next" warning to those industries in which dust may be a danger. It is estimated from census figures that twenty-eight thousand plants in the United States, employing over a million persons and with an annual production of ten billion dollars, are subject to the hazard of dust explosions—a nice list of prospects, as our insurance friends would say. But in this case, the best insurance is prevention, made possible by extended studies of existing hazards, research into the cause of explosions and the education of industry to a better appreciation of the dust menace.

Modern Coke

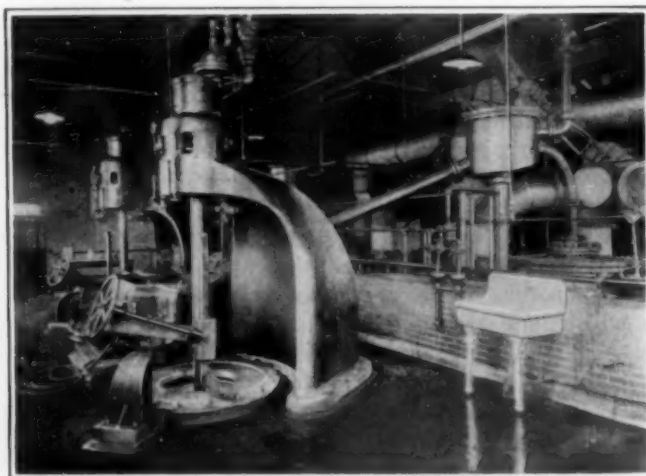
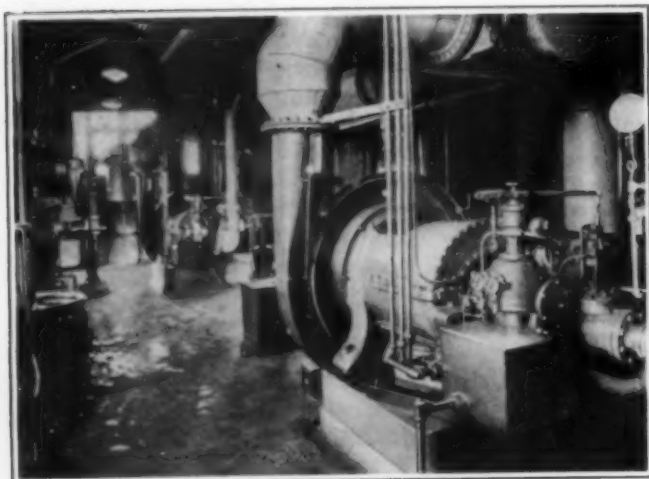


Above—Coke Side of New Battery of Wilputte Ovens



At right—View of the Top of Battery. Note single-hopper larry and single charging hole; the double hydraulic main and off-take system requires the crude-gas cross-over main shown in this view

Coal Processing in a New England Plant



Gas Exhausters (Single-Stage G. E. Units) Are Shown at Left. Sulphate Centrifugals Are Seen at the Right

Ovens That Give High Yields of Gas and Byproducts

By R. S. McBride

Assistant Editor, Chem. & Met.

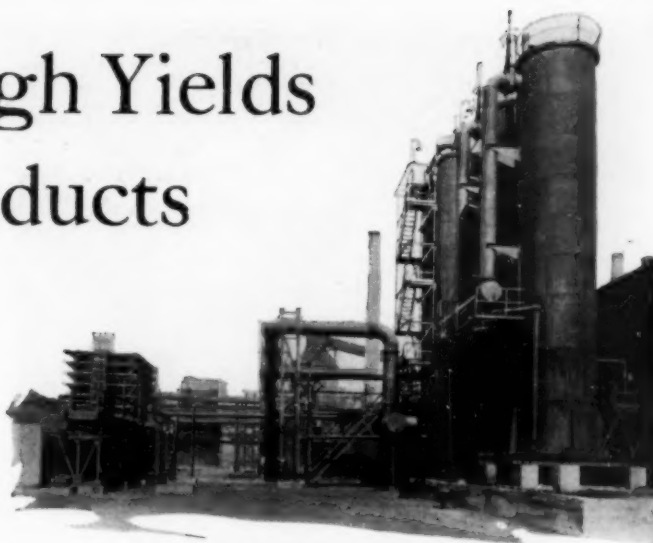
UNUSUALLY high yields of gas and byproducts with high oven-heating efficiency are contributing to the satisfaction which engineers and management officials of the New England Fuel and Transportation Company feel in their new battery of coke ovens. This installation was required to expand the coke-making capacity of their plant at Everett, Massachusetts, which furnishes coal-gas base load for the affiliated Boston Consolidated Gas Company, and the coke both for the affiliated Mystic Iron Company and for distribution as household fuel in the Boston district.

The fifty-five Wilputte coke ovens which make up this new battery were erected during 1926 with what is probably record speed of construction. The first piles for the plant were driven in April, and on December 15 of the same year the first coke was pushed from the oven. Thus barely seven months elapsed from the completion of excavations to the initial heating of the refractory work. And fortunately this speed in construction was attained without any apparent sacrifice of refinement in design or efficiency in plant operation.

In numerous respects this new plant incorporates novel features. The most distinctive characteristic is the system for charging the ovens through a single opening with a single-hopper larry car. This method of charging requires the use of two gas-collecting mains, one on each side of the battery, so that the initial rush of gas when fresh coal is introduced can escape from both ends of the oven. By the scheme of charging used this richest gas is conserved, because the oven during charging is connected with the collecting mains. Thus, not only are the flame and smoke nuisances of charging eliminated, but the loss of valuable products which commonly occurs during charging is prevented. This system of charging is a patented development of the engineers of the New England Fuel and Transportation Company. It has been very effectively incorporated into this plant and is proving its intrinsic merit, both by increases of byproduct gas yields and by the marked improvement in working conditions about the battery.

This coke-oven plant represents an interesting industrial example of the integration of industry. The owner company is a part of the Massachusetts Gas Companies system which has, through various subsidiaries, coal mines, a fleet of coal-handling vessels, one of the finest coal-handling docks and yards in all New England (adjoining the coke department), coke ovens, blast furnaces, a wholesale and retail fuel-marketing system, and a city-gas distributing system. Thus from the mine to the bin or the meter of the ultimate customer the coal is handled as a part of a co-ordinated business enterprise.

The coal mixture used in the new Wilputte ovens con-



General View of Byproduct Plant at Everett, Mass.

sists of "Federal" high-volatile West Virginia coal, Pocahontas low-volatile coal, and Imboden seam low-sulphur high-volatile coal. This mixture affords the requisite high yield of gas, a strong metallurgical coke, and a low sulphur content in both gas and coke. The yields of all products are, indeed, rather unusual, as will be seen from the figures given later in this article.

COAL is received at the affiliated company's docks and handled through the yard by the same equipment which has been in use for years to supply an installation of 400 Otto-Hoffman coke ovens owned by the same company. Hence little new coal-handling equipment was required. The coal is brought from conveyors at the top of the bunkers on the old battery to a 2,000-ton two-compartment bunker above the new ovens. This bunker is of structural steel frame work filled with pre-cast reinforced concrete slabs about 4 in. thick. This design was selected instead of the more common steel-plate design in order to eliminate corrosion damage commonly a serious factor on bunker plate in such position. The pre-cast slab concrete construction will permit replacement of any damaged unit if this should prove necessary.

The oven-heating system used in this plant is the latest adaptation of the Wilputte oven. The heating gas burns upward for one-half-hour periods in one-half of the flues in each heating wall. The products of combustion accumulate in a horizontal flue at the top of these heating walls, pass to the top of the heating flues at the other half of the wall, downward through these heating flues, and out through the individual regenerator sections to the waste-products flue under the battery that conducts them to the stack. In the next half-hour period the flame travels in the reverse direction, burning up through the other half of the flues and the products then escape through the flues and regenerator sections in the first half of the wall.

The amount of gas entering each heating flue is controlled by accurately sized ports in the replacable refractory gas nozzles, set in the usual fashion at the base of each heating flue. The air for combustion is preheated in the regenerators, a separate regenerator serving each individual heating flue. The amount of air entering each regenerator is separately controlled by holes drilled and accurately reamed to size in the air-supply pipe. The



Ammonium Sulphate Storage

The portable elevator in the foreground is used for piling sulphate in storage, for elevating sulphate into hopper of bagging machine, and for car loading.

proportioning of air and gas for each heating flue is, therefore, independent of all other considerations.

The distribution of products of combustion passing downward from the horizontal flue into each heating flue is controlled by the size of the opening at this point. The use of separate regenerator chambers for each heating flue prevents any intermingling of the products until they reach the collecting flue at the base of the regenerators. In this scheme at each point the gas, air, products, and flame control is independently adjustable for a single function.

To prevent accumulation of carbon on the gas nozzles, where it is deposited by cracking of the fuel gas, a supply of decarbonizing air is introduced through the gas gun during each period on the "off" side of the battery. This air passes through the gas nozzle, burns off any carbon found there, and the products pass out to the stack with the main body of products of combustion. The reversal machines which automatically open and close the gas cocks at half-hour intervals also automatically turn on and turn off this decarbonizing air supply. One reversal machine operates the gas cocks on the pusher side and the decarbonizing air cocks on the coke side of the battery. The second machine operates the other two sets of cocks for gas and air. A third reversal machine, operated by the same automatic clock control opens and closes the four duct control dampers, two each on the waste-gas ducts and the air-supply ducts.

REGULATION of the air supply for combustion and of the oven stack draft is accomplished by two Shallcross regulators. The air supply is introduced under pressure by an electric-motor driven Sturtevant Silent-vane fan. The air supply for decarbonizing the gas jets is supplied to the system at about one pound pressure from a motor-driven single-stage centrifugal compressor. The heating gas is measured to the battery with a Connersville impeller-type meter and an automatic continuous record of its heating value is kept with a Thomas calorimeter. The temperature of the heating gas is also under control. Hence the smooth functioning of the battery is practically independent of those variables such as stack temperature, atmospheric temperature, and the like factors which often cause highly undesirable variation in oven performance. It is particularly notable that auto-

matic equipment has been used at every point where maintenance of conditions is essential to smooth functioning of the ovens.

When operating with reasonably dry coal, containing not over 3 per cent of moisture, the larryman finds no difficulty in discharging all of the coal into an oven, closing the charging hole, and luting it down within about one minute of the time he starts to charge an oven. It is not necessary for him to wait for the pusher man to level the coal before completing this operation unless the moisture content of the crushed coal is above 3 per cent; but with coal of higher moisture content it is necessary to level the coal in the oven before all of it will flow out of the larry car.

Although tests have indicated that the coal distributes itself along the oven surprisingly well it is the invariable practice to level the charge. During this leveling operation a steam jet is opened into each of the off-take pipes so that there will be a slight entrance of air through the leveling bar door instead of the usual outrush of smoke and flame at this point. Despite the fact that only a single charging hole is used the spillage of coal from the oven during leveling is no greater than normal for a properly handled oven of any type.

OVENS at this new plant are approximately 40 ft. 6 in. long, 11 ft. 10 in. high, and from 15 to 17 in. wide, measured in the coal space. Each will hold a maximum of 31,000 lb. of coal, but in normal operation the company is charging 30,000 lb. The battery is designed to operate on a coking time as short as 15 hours, but the present practice requires operation with a gross coking time of nearly 17 hours, the net time that the charge is in the oven being 16 hours and 25 minutes.

The crew for operating an installation of this type of oven consists of nine men per shift—a foreman, a heater, a pusher man, two luters (one on each side of the battery), a hot-car operator, a door-machine man on the coke side, a coal-larry man, and a stand-pipe maintenance man. On the day shift there is also one mud mixer who grinds enough mud for 24 hours' use and any yard labor or clean-up men who may be required to insure good housekeeping. It is not known just how many ovens this crew could operate, but certainly they could handle much more work than required on this single battery of 55 ovens. In the case of several of the jobs one man would suffice for two such batteries and in case of one or two jobs, even for three batteries. In other instances duplicate workmen would be required.

Raw gas from the two collecting mains is brought together near one side of the battery by an overhead connection of 30-in. main. In order that the withdrawal of gas from the two sides of the battery may be properly equalized there is a butterfly valve placed in one of the mains just ahead of the Y where the two crude gas lines join. This butterfly is manually controlled and is so adjusted that the temperature in the two lines will be the same. This is done on the theory that if an equal amount of gas is taken off on each side and subjected to an equal amount of spraying the temperature at this point should be equal. In practice this theory seems to be entirely sound and the very simple arrangement provided appears to be adequate to distribute the gas accurately between the two sets of off-takes.

Just beyond this junction Y the total amount of gas made passes through another butterfly valve controlled with the latest type of Shallcross regulator. The regu-

lator functions with a two-speed mechanism and controls both butterfly valve position in the raw gas line and exhauster speed in the byproduct house. The high speed butterfly valve adjustment cares for sudden rushes of gas during charging and the low speed provides accurate pressure regulation during normal operations. Whenever the butterfly valve can not alone care for the required changes it passes outside of its normal working zone and thereby automatically causes the exhauster to speed up or slow down until the valve returns within its working zone. The pressure maintained at this junction point by the regulator system is between one and two millimeters above atmospheric.

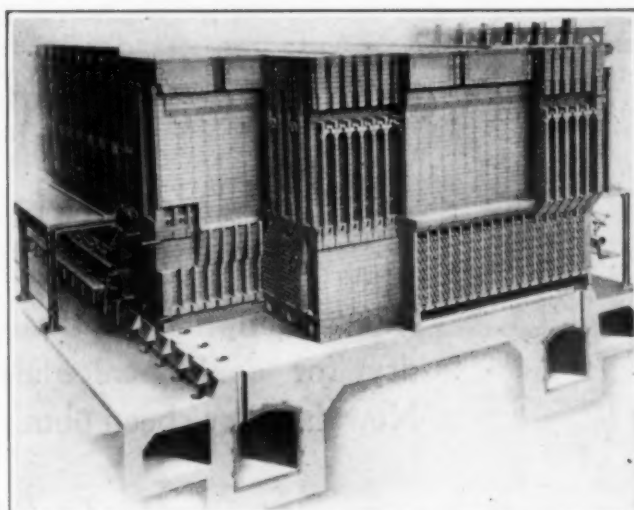
The total gas made is carried from the battery to the byproduct department where it passes in turn through a grid-filled primary washer-cooler, an exhauster, a tar extractor of the P. & A. type, a heater, an ammonia saturator, an acid-spray separator, and a final cooler, to the station meter. The metered gas from the Wilputte battery then joins the gas from the Otto-Hoffman oven plant and is taken to an adjoining plant owned by the Boston Consolidated Gas Company where it is purified, ready for mixing with water-gas to make up the city supply of Boston.

The primary washer-coolers are steel shells approximately 10 by 60 ft. filled with wood slat trays laid criss-cross. Cooling takes place by direct contact with water, forming a weak ammonia liquor which is cooled by circulation through 46 banks of water-cooled coils, each bank containing 32 pipes. The cooling coils of sheradized pipe are cooled by salt water which is handled through a galvanized pipe supply line. The exhauster, a single-stage turbo steam-driven unit, pulls the gas from the battery through the primary cooler and forces it through the balance of the byproduct system. This exhauster unit is turbine operated at 7,600 r.p.m. with a multi-jet condenser unit having salt-water cooling.

BYPRODUCT equipment used for ammonium sulphate manufacture consists of reheaters, separators, centrifuges, acid-spray separators, and sulphate-handling equipment. The saturators are of lead-lined cast iron 13 ft. in diameter; the acid-spray separators are lead-lined steel shells of the cyclone type. Lead-lined cast iron is used for the drain tables. Unloading plows are used for removal of sulphate from the baskets. The Fletcher centrifugal driers are 40 in. units of the suspended cantilever type driven by steam turbines mounted directly on top of the frame. The frames are of novel design, being specially shaped to suit direct turbine drive instead of the usual frame adapted from the old engine and belt drive.

For the year 1927 the gas produced had a heating value averaging 608 B.t.u. per cu.ft. It is interesting to note that this gas has a very low inert content, the nitrogen percentage averaging 3.6 per cent for the calendar year.

Operating results from the new battery are available for 1927. These show very favorable yields, especially of gas and ammonia. The operating engineers believe that the single-charging-hole system should be credited with a substantial part of the advantage over the yields which would have been anticipated in an ordinary type of installation using the same coal. Not only does this scheme save the richest gas given off during the initial minutes, but it also, because of two off-takes, reduces the



Phantom View of Wilputte Oven as Installed at the Plant of the New England Fuel and Transportation Company

length of the travel of the gas within the oven. This last advantage combined with the cool top is, of course, favorable to the production of ammonia and high B.t.u. gas; and it is likely to result in a minimum production of naphthalene, pitch, and like objectionable constituents of the raw gas.

For the calendar year 1927, the coal averaged 2.82 per cent moisture, and 32.19 per cent volatile; the B.t.u. in the total gas per lb. of dry coal was 3430, and the B.t.u. used to carbonize a lb. of dry coal was 1085. Per net ton of dry coal there was produced 10.46 gallons of tar, and 24.7 lb. of ammonium sulphate.

The coke made in the Wilputte ovens is first screened to give blast-furnace coke and under-size material. The latter goes to the domestic-coke division of the company where it is rescreened into stove, nut and breeze, mainly to supply household fuel requirements. The Otto-Hoffman ovens of the company are operated on the same coals and furnish foundry coke. The under-size of this material also goes to domestic sales division for household supply.

Tin Can Corrosion

Normally one thinks of tin as more noble than iron, but the inverse is true when tin plate is used for cans for certain vegetables and fruits. This reversal of position of tin and iron in the electrochemical series was recently reported by E. F. Kohman and N. H. Sanborn, of the National Canners Association.

In the absence of oxygen in the food solutions there is a tendency for tin, if unlacquered, to dissolve, and the iron, being cathodic, is protected from corrosion. However, if a lacquer is used to coat the tin plate the protective action of the tin upon the iron is removed and the plate perforates very rapidly at any point where there is minute imperfection in the tin coating. These results, therefore, explain why lacquered plate, which seemed theoretically a better protection against perforation, is actually poorer, as has been found by practical experience in fruit canning work of the past few seasons. It is pointed out that the presence or absence of oxygen or the presence or absence of oxygen acceptors in the solution was frequently sufficient to determine whether the tinned areas or the exposed iron areas were subject to chemical attack.

New Heat Transfer Data for the Scrubber Designer

The assumption that oil-gas may be considered as dry for cooler calculations is usually untenable. New data have been obtained with water-saturated gas

By Ted Rosebaugh

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FOR A NUMBER of years past much work has been done in the study of heat transfer in tubular condensers of designs peculiar to gas plants. In oil-gas and water-gas plants tubular condensers are not, however, in common use for cooling or condensing gas. The grid packed scrubber is the more popular type of equipment here, chiefly because it removes tar, naphthalene and small amounts of lampblack from the gas during the initial stages of cooling.

No data have been available on the coefficients of heat transfer for scrubbers of this latter type used in the oil-

gas and water-gas plants. Without a knowledge of such coefficients, it is impossible to design a scrubber from a heat transfer standpoint. The present article seeks to fill this deficiency as has already been done in the case of tubular condensers by the report of the American Gas Association committee for 1925 on condensing and scrubbing, which presents quite thoroughly the committee's work on this subject. Much of the data given was taken from plant logs and so represents actual operating conditions. From this report and other sources there is available a fairly complete story of tubular condensers, with overall heat transfer coefficients analyzed sufficiently and given in such form as to be of practical use in condenser design. Coefficients have been determined for cooling dry gases as well as gases saturated to different degrees with water and other vapors.

IN THE CASE of either type of equipment the coefficient of heat transfer is much greater for gas saturated with water vapor at the inlet than it is when the gas is dry or saturated to only a slight degree. In designing scrubbers, washer-coolers and similar equipment, the gas is frequently assumed to be dry, with the heat content considered merely as a function of the specific heat and temperature. Actually this is seldom the case. As is generally true in most gas-oil and water-gas plants, the gas is saturated at the temperature it leaves the washbox. With a saturated gas the heat carried in the water vapor is a large percentage of the total heat that must be removed to accomplish a desired amount of cooling or scrubbing, particularly at the higher temperatures.

At a temperature of 200 deg. F., which is a possible washbox outlet condition for oil-gas sets, over 90 per cent of the heat is carried in the water vapor. The total heat content of saturated oil-gas above 60 deg. F. is illustrated in Fig. 1. This curve represents the heat extracted per 1,000 cu.ft. of oil-gas (corrected to 60 deg. F. and 30-in. barometer) in order to reduce its temperature to 60 deg. F., with the gas saturated with water vapor at various inlet temperatures. The upper curve is an enlargement of the 60-130 deg. range on the lower.

As the gas cools, its moisture partially condenses and its heat is given up as latent heat. The rate of condensing or the overall coefficient of heat transfer, is high during the initial stages of cooling. It falls off rapidly with de-

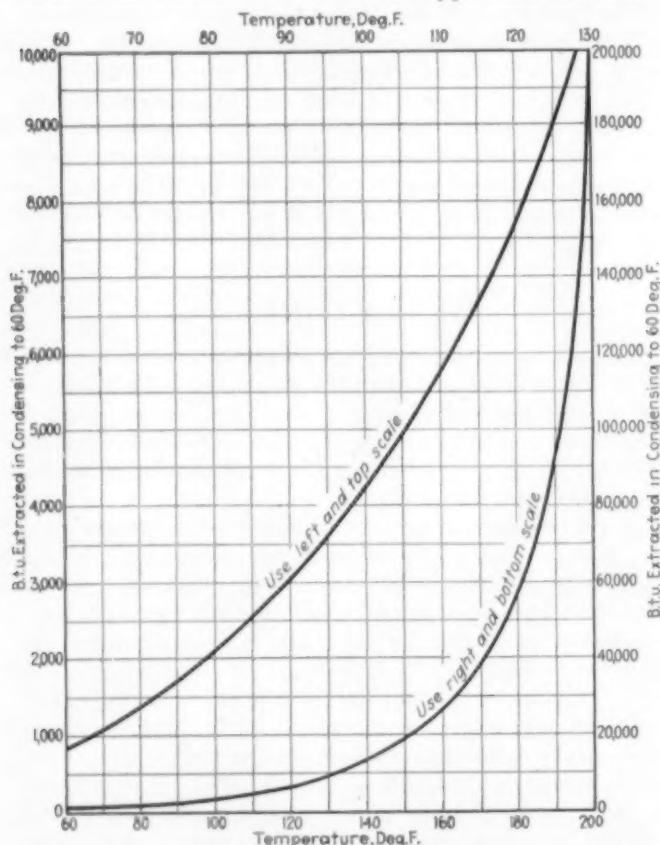


Fig. 1—Total Heat Content of Water-Saturated Oil-Gas above 60 deg. F. in B.t.u. per 1,000 cu.ft. (Gas corrected to 60 deg. F. and 30-in. barometer).

The upper curve is an enlargement of the 60-130 deg. range on the lower curve with the ordinate and abscissa values at the left and top.

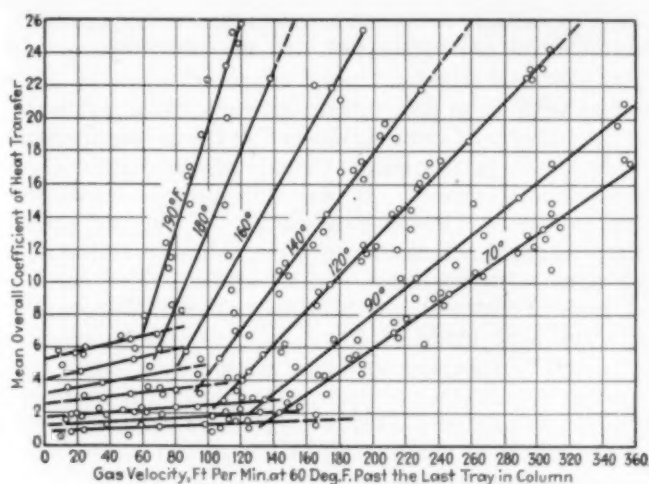


Fig. 2—Effect of Gas Velocity on the Mean Overall Coefficient of Heat Transfer for Various Inlet Gas Temperatures.

crease in temperature, and approaches a straight line in the vicinity of 60 deg. F. which is the approximate outlet gas temperature of most scrubber and washer-cooler units (depending of course, upon the design of the unit and the temperature of the cooling water available). Likewise, as the temperature falls the proportion of water vapor to gas decreases and the overall coefficient of heat transfer approaches that for a dry gas.

The overall coefficient of heat transfer is expressed in B.t.u. per hour per square foot of cooling surface per

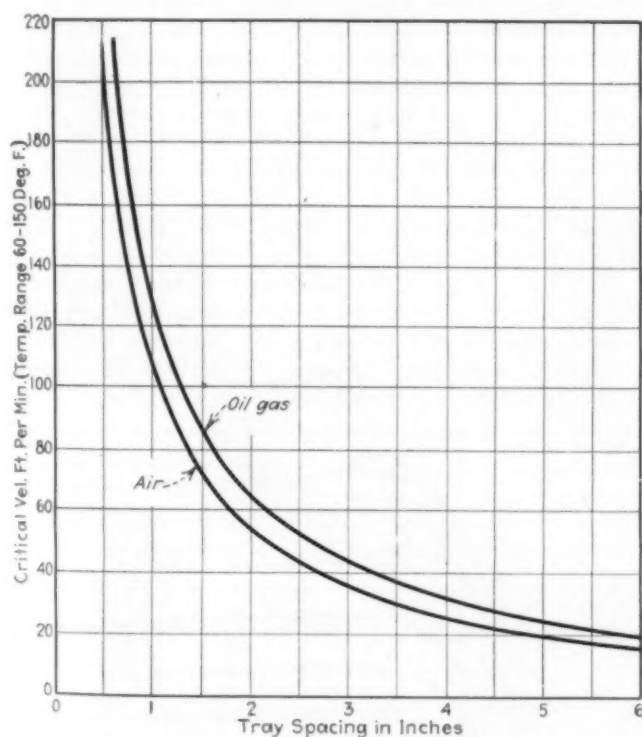


Fig. 3—Critical Velocities, Feet per Minute, for Oil-Gas of Sp. Gr. 0.42 and Air, for Various Tray Spacings.

These are actual velocities at existing temperatures. The curves do not allow for the effect of staggering.

deg. F. mean temperature difference. It indicates that the temperature difference is a mean, based on the temperatures of the heating and cooling mediums. The term "overall" indicates the transfer to be directly from gas to water in the case of grid-packed scrubbers and does not take into consideration the individual thermal resistances of the gas and vapor films. The coefficient for a dry gas has previously been determined quite accurately

for various types of heat transfer apparatus and results are available in several texts. The figure is in the neighborhood of from two to three B.t.u. per hour per square foot of wetted cooling surface per deg. F. mean temperature difference. For a gas saturated with water vapor the coefficient varies over a wide range, depending upon the inlet gas temperature and the gas velocity past the condensing surface. At the lower temperatures (70-90 deg. F.) with a gas speed corresponding to the beginning of turbulence—the critical velocity—the value ranges from four or five to 30 or higher for nine or ten critical velocities. The latter velocities are well within the allowable range for a pressure drop of one in. of water

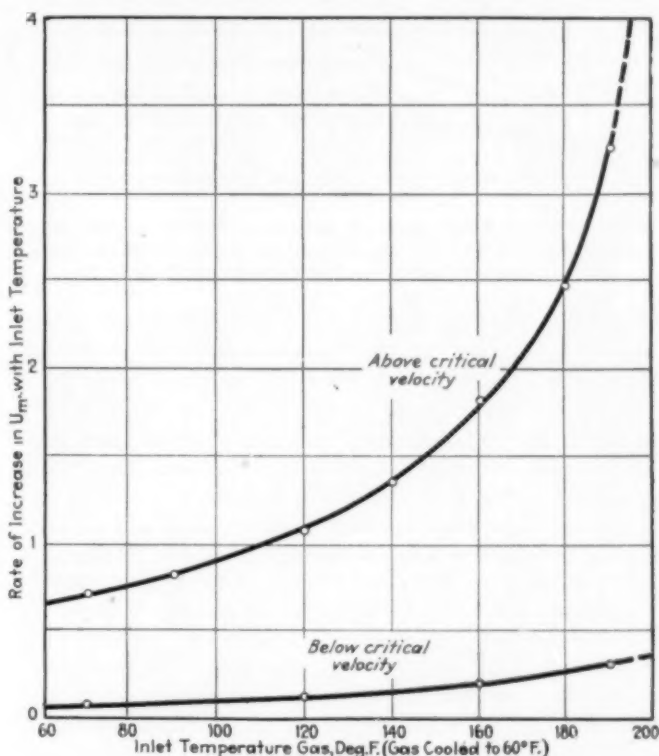


Fig. 4—Rate of Increase in the Mean Overall Coefficient of Heat Transfer with Velocity for Various Inlet Gas Temperatures

through the trays of the scrubber. With nine or ten critical velocities, however, at an inlet gas temperature of 190 deg. F., the predicted coefficient would be about 1,000, but the pressure drop would be excessive. The limit at this temperature for a 1-in. pressure loss seems to be two critical velocities.

AS WAS STATED the coefficient here is a mean overall value since it is determined by inlet and outlet conditions of both the scrubber heating and cooling mediums. The rapid condensation during the initial stages of cooling gives a high co-efficient at the start which decreases as the bottom of the column is approached, making the overall coefficient for any case an average value, the mean of a number of coefficients from the bottom to the top of the column. For design purposes this mean overall coefficient is very convenient, for it is necessary to know only the inlet gas temperature and the degree of cooling desired together with the temperature of the cooling water available. After selecting the outlet water temperature (a function of the "water efficiency"), the height of the tray column for a given tray construction may be determined.

In scrubbers of the grid-packed type where the cooling water comes in direct contact with the gas in counter-

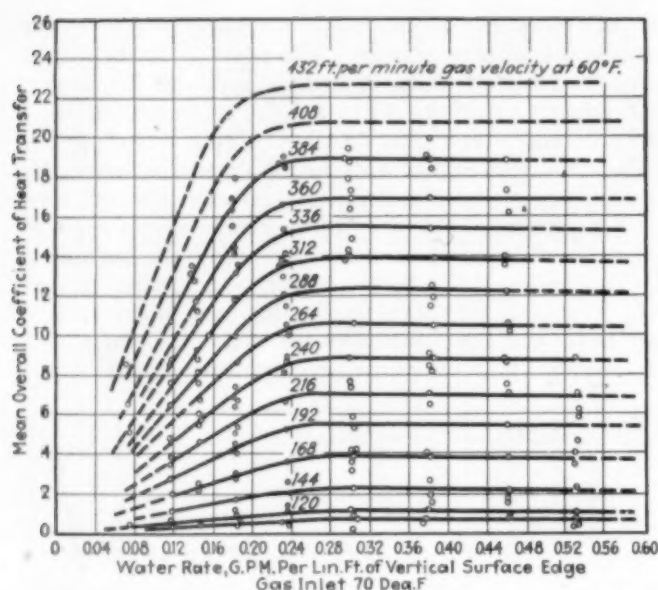


Fig. 5—Effect of Water Rate on the Mean Overall Coefficient of Heat Transfer for Various Gas Velocities and Inlet Gas Temperatures. Constant Inlet Gas Temperature of 70 deg. F.

current flow past the wetted board surfaces of the grids, a scrubber will have another function aside from that of acting as a condenser. It must in addition, serve as a scrubber for the removal of tar in the case of a water-gas plant, tar and lampblack in oil-gas plants, and perhaps cyanide or other objectionable ingredients. This takes place in the first two water scrubbers found in oil-gas plants. The large amount of condensate and foreign material removed in these scrubbers could not be handled satisfactorily in a tubular condenser. On the other hand, the grids or trays of the scrubber or washer-cooler type of condenser seldom give difficulty from deposits provided the flow of water is sufficient and is properly distributed to cover the board surfaces completely. If tar, lampblack and so on are deposited on the board surfaces, the effect on the heat transfer coefficient is insignificant compared to the high thermal resistance such a deposit would occasion on the tube walls of a tubular condenser.

This secondary function does not greatly affect the design of a scrubber. The most logical procedure is to design it primarily as a piece of heat transfer apparatus. If the correct overall heat transfer coefficient is combined with a practical tray spacing and arrangement from a stoppage standpoint, the scrubber will function in the most economical manner as a condenser and, as a secondary duty, remove as thoroughly as possible the various impurities. If these objectionable ingredients have not been sufficiently washed out when the cooling of the gas has been accomplished, their removal becomes a special problem of washing and not one of cooling or condensing.

THE NEED for overall heat transfer coefficients for grid-packed scrubbers used for water-saturated gas is quite apparent. Without such coefficients, the design of a scrubber becomes mere guess work. The present paper seeks:

1—To present for the first time, it is believed, these coefficients of heat transfer for a wide range of conditions. The coefficients represent results obtained under actual operating conditions and are suitable for use in scrubber design.

2—To show the effect on the coefficient of (a) water rate, (b) gas velocity, (c) inlet gas temperature.

3—To indicate for practical operating conditions the most efficient (a) water rates, (b) gas velocities.

Experimental Work—The experimental work in conjunction with these determinations was carried out with saturated oil-gas of calorific power 550 B.t.u., and specific gravity 0.423, at the Potrero Plant of the Pacific Gas and Electric Company. It was necessary to construct special apparatus for this work as the regular plant equipment could not readily be controlled to give the desired range of temperature and saturation. Two scrubbers, each packed with wooden trays or grids were built. The trays were made of $\frac{1}{2} \times 4$ in. pine boards, spaced 1 in. apart. Each tray was laid at right angles to the one preceding it, giving a criss-cross arrangement, with every second tray staggered so that the boards came directly over the center of the channel of the second lower tray. The total height of each tray column was $17\frac{1}{2}$ ft.

THE FIRST scrubber was used as a combined saturator and heater. Water was circulated by means of a pump, while the surplus was held in a storage tank into which the seal discharged. The water in this tank could be heated with a steam coil to any desired temperature thereby supplying gas saturated at any given temperature to the inlet of the second scrubber. The flow of gas was measured with an orifice meter. Sea water was used in the second scrubber which served as the condenser on which the performance data was collected. With this apparatus, data was taken for a wide range of conditions for water and gas rates, the inlet gas temperature varying from 65 deg. F. to 200 deg. F., with the inlet gas in each case 98 — 100 per cent saturated with water vapor as determined by wet and dry bulb thermometers. The sea water was available for the condenser at a temperature of 58 — 60 deg. F. Sufficient data was collected for the determination of over 400 coefficients.

In the experimental tests made, the following data were taken: time, water rate by meter, total pressure on scrubber in in. of water, pressure drop through scrubber in in. of water, gas rate by orifice meter, wet and dry bulb temperatures of inlet and outlet gas, inlet and outlet water temperature, temperature of gas at orifice meter, temperature of atmosphere.

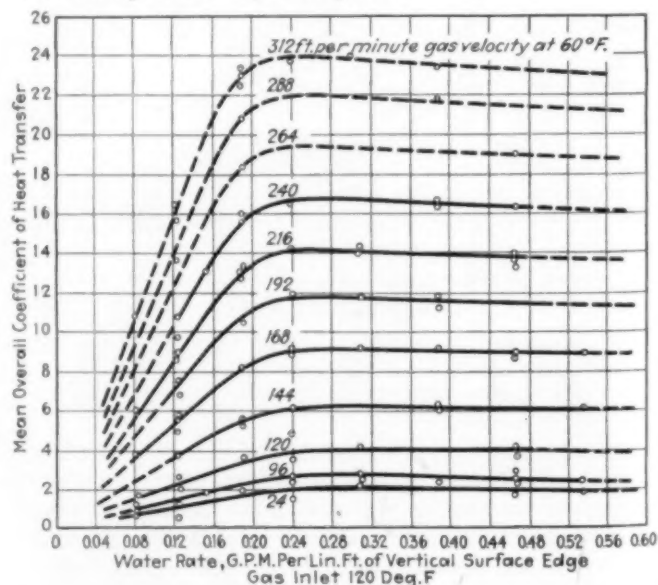


Fig. 6—Effect of Water Rate on the Mean Overall Coefficient of Heat Transfer for Various Gas Velocities and Inlet Gas Temperatures. Constant Inlet Gas Temperature of 120 deg. F.

Because of the large number of observations made, the data is summarized in the curves which are given herewith.

Determination of Coefficients—The following familiar form of Newton's law for steady conditions was used in calculating the mean overall coefficient of heat transfer in every case:

$$Q = U_m A Mtd$$

Q —rate of heat flow from gas to water in B.t.u. per hour. Q was determined from Fig. 1, knowing the gas rate as measured by orifice meter.

A —total sq.ft. of condensing surface in the scrubber. It includes only the sides and bottom exposed edges of the trays, deducting for intersections, as each tray lay at right angles to the one below it. The walls of the scrubber were also included, since the last board of each tray was spaced 1 in. from the wall, making this area available as condensing surface.

Mtd —mean temperature difference determined by the method of Haug and Mason of the United Gas Improvement Company as outlined by them in the report of the American Gas Association committee on condensing and scrubbing for 1925. This report may be referred to for a detail of their method. It takes into consideration the fact that equal changes in temperature of saturated gas do not represent equal amounts of heat loss during condensation. As it is demonstrated by the curve of heat content of saturated gas shown in Fig. 1 that equal changes in temperature do not represent equal amounts of heat loss, the logarithmic mean temperature difference commonly used in heat transfer work is incorrect. This was pointed out by the above named committee.

U_m —mean overall coefficient of heat transfer from gas to water, from inlet gas temperature to 60 deg. F., expressed as B.t.u. per hour per sq.ft. of tray surface per deg. F. mean temperature difference between gas and water.

IN DISCUSSING water rates for grid-packed scrubbers the rate is often given in gal. per sq.ft. of scrubber cross-section, in gal. per sq.ft. of tray surface, or frequently it is expressed as so many gal. per 1,000 cu.ft. of gas passed through the scrubber per minute or per hour. Considering the several possible arrangements of trays or grids, the above methods are not comparable. Since it is important to be able to compare the performance of one type of scrubber with another, regardless of tray construction, and since the use of water is an im-

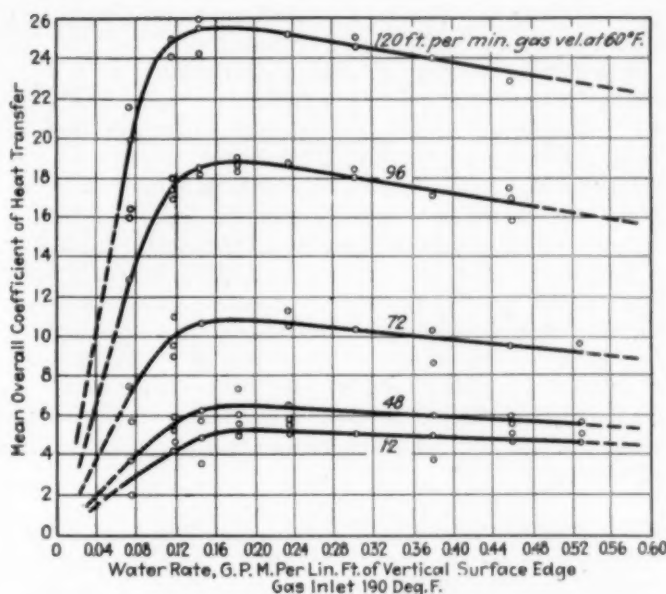


Fig. 4—Effect of Water Rate on the Mean Overall Coefficient of Heat Transfer for Various Gas Velocities and Inlet Gas Temperatures. Constant Inlet Gas Temperature of 190 deg. F.

portant economic factor to consider in operating, the method of specifying water rate should be applicable to all cases. For this reason, the water rates in this work are given as gal. per min. per linear ft. of vertical surface edge. To illustrate this method of specifying water rates, consider $\frac{1}{2}$ -in. trays spaced $\frac{1}{2}$ in. apart. Each ft. of length of tray will have two ft. of edge for water to run over, referred to here as lineal ft. of vertical surface edge. For a water rate of 0.2 gal. per min. per lineal ft. of vertical surface edge using this tray size and spacing, the water rate expressed in gal. per min. per sq.ft. of scrubber cross-section will be $12 \times 2 \times 0.2 = 4.8$ which gives no indication of the actual wetted area.

The ideal condition of water distribution is to have a water film of uniform thickness over all the board surfaces. It is very important to approach this ideal closely as uneven distribution will cause flooding in some spots with comparative dryness in others. Further, it is found that too great a water rate likewise causes flooding with consequent reduction in condensing surface and coefficient. The maximum appears to be about 0.60 gal. per min. for $\frac{1}{2}$ -in. tray spacing and about 0.80 for 1-in. spacing. Closer spacing than $\frac{1}{2}$ -in. is likely to cause coalescence of the steams on adjacent surfaces and hence will cause flooding.

In the test work done in conjunction with this study, care was taken to see that the water distribution was as near perfect as possible. To further aid the distribution sprays used at the top of the column, the bottom tray of each tray section was serrated in saw-tooth fashion to gain the effect of a rain on the tray section below it.

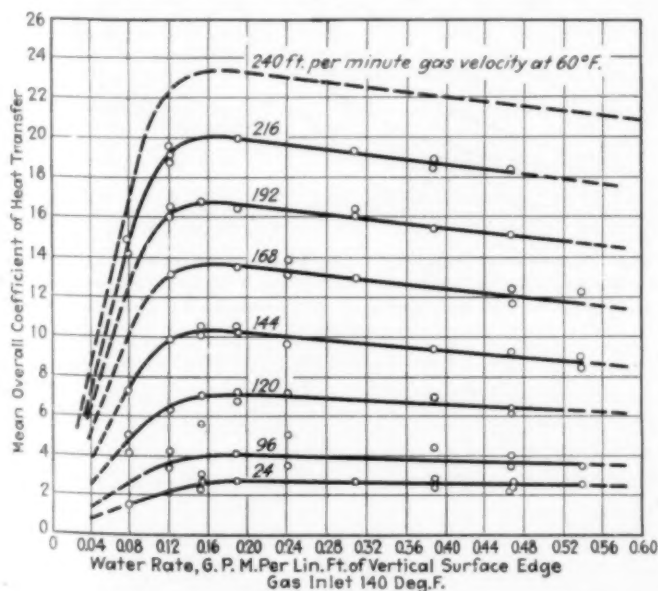


Fig. 7—Effect of Water Rate on the Mean Overall Coefficient of Heat Transfer for Various Gas Velocities and Inlet Gas Temperatures. Constant Inlet Gas Temperature of 140 deg. F.

THE effect of velocity on the coefficient is shown for various inlet gas temperatures in Fig. 2. The coefficients plotted are for rates varying from 0.20 to 0.40 gal. per min. per lineal ft. of vertical surface edge. However, this variation has practically no influence on the coefficient as will be shown later by the curves of coefficients plotted against water rates for various constant gas velocities and inlet temperatures. The curves are practically flat over this range of water rates. In particular, Fig. 2 shows clearly the necessity for maintaining gas velocities above the critical in obtaining favor-

able coefficients. The knee of each curve represents this condition of the beginning of turbulence.

For a tray spacing of one in., considered as a 1-in. channel, the critical velocity is 130 ft. per min. at 60 deg. F. Since the gas was cooled to approximately 60 deg. F. in all of the tests, it seemed advisable to refer to gas velocities in terms of critical velocities at 60 deg. F. or in other words, the gas velocity past the last tray in the column. This places the data on a comparable basis and although the inlet temperatures are different for a constant outlet gas temperature, the rapid condensation at the start and consequent higher velocity due to temperature effect on the volume is taken care of by the increase in coefficient. Both velocity and temperature must, of course, be considered in their influence upon the coefficient. All of the velocities given are for a temperature of 60 deg. F.

CRITICAL velocities at various tray spacings for oil-gas and air are shown in Fig. 3. In computing the critical velocities, the change in viscosity over a temperature range from 60 to 150 deg. F. was found to have slight effect on the velocity. The temperature is referred to only to show that in cases where the outlet gas temperature from the scrubber is higher than 60 deg. F. that the change in viscosity due to temperature may be neglected, in so far as this factor effects the critical velocity.

As Fig. 2 shows, the increase in coefficient is quite rapid above the critical velocity. Likewise the increase with increased inlet gas temperature is very rapid. In Fig. 4, the slopes of the lines of constant temperature in Fig. 2, were plotted against inlet gas temperatures. This curve shows the rapid increase in the coefficient for a fixed velocity with increase in inlet gas temperature. For example, in Fig. 2, at 190 deg. F. and a critical velocity of one (130 ft. per min.) at the outlet to the tray column at 60 deg. F., the coefficient is found to be about 30 if the 190 deg. line be extended to intersect the 130 ft. velocity line. This intersection lies just off the top of the plate. In Fig. 4, for an inlet temperature of 190 deg. F. the rate of increase in coefficient with velocity is 3.25. For ten critical velocities then, instead of one at which the coefficient is 30, the coefficient would be $10 \times 3.25 \times 30 = 975$. Likewise for an inlet temperature of 200 deg. F. the rate of increase, about five, indicates that the coefficient would be in the neighborhood of 1,800, approaching 2,500 or over at 212 deg. F. These predictions, of course, fall beyond the range of the tests, but they are interesting as a check, since the coefficient for steam is about this amount.

In Figs. 5, 6, 7 and 8 the effect of varying the water rate and gas velocity for inlet gas temperatures of 70 deg., 120 deg., 140 deg., and 190 deg. F. is shown. Between 0.20 and 0.40 gal. per min. per linear ft. of vertical surface edge, the coefficient is practically constant for a given velocity. Beyond a rate of 0.60 there is a tendency for the water to form in streams and leave the board surface instead of flowing as a film of more or less uniform thickness. With this condition on trays spaced one inch or less apart, there is danger of flooding.

In these last four sets of curves, inlet temperatures were held at various constant values for varying gas velocities. The effect of the water rate on the coefficient for constant exit gas velocity and various inlet temperatures may easily be observed by picking one curve at any definite velocity from each of Figs. 5 to 8.

Attention should be drawn here to the fact that for the tray arrangement used, the critical velocity was about 120 ft. instead of 130 ft. per min. on account of the staggering and the numerous changes in direction of gas flow resulting from the criss-cross placing of trays. However, the theoretical figure of 130 ft. per minute is here considered one critical velocity for purposes of uniformity and for making the results applicable on a critical velocity basis to other cases. The error is on the safe side.

The effects of velocity and temperature are demonstrated by Fig. 9. This set of curves is convenient for determination of the overall coefficient for a given inlet gas temperature and various gas velocities. If the tray spacing is not one in., or in other words, if the critical velocity is not 130 ft. per minute, then the curves must be referred to in terms of critical velocities through use of Fig. 3. This may be done by simple proportion between the respective critical and actual velocities. Although the critical velocity is theoretically 130 in Fig. 9, there is a marked change in the coefficient at a velocity of about 96. This difference between the actual and theoretical critical velocities brings out the effect of staggering the trays.

FROM an operating viewpoint there are two important economic factors in the performance of a scrubber or washer-cooler. First, there is the water requirement and second, the pressure drop through the scrubber. The minimum water rates for various operating conditions have already been indicated. The pressure drop through the tray column should naturally be

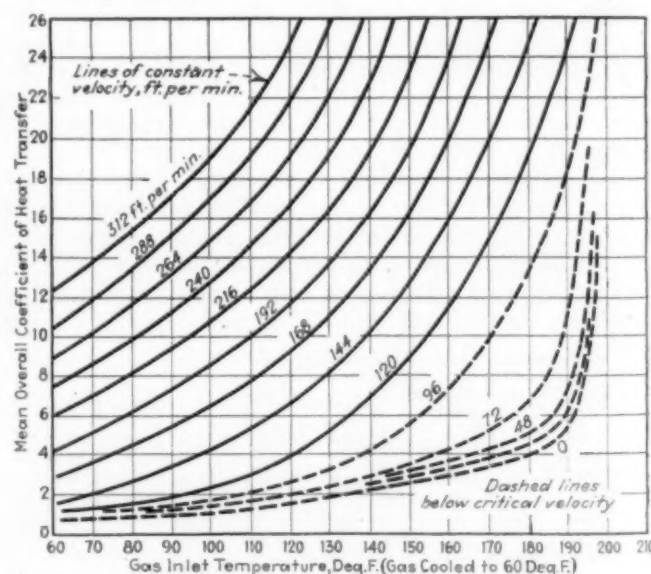


Fig. 9—Effect of Inlet Gas Temperature on the Mean Overall Coefficient of Heat Transfer for Various Gas Velocities. Water Rate 0.20 to 0.40 gal. per min. per linear ft. of Vertical Surface Edge.

kept at a minimum. Increasing velocity to increase the coefficient and therefore the capacity of the unit at the sacrifice of pressure drop, is justifiable in some cases. However, this is purely a problem to be figured out with a knowledge of boosting costs, and so on, for every particular case.

In conclusion, the author wishes to acknowledge his appreciation for the supervision of Mr. Frank Wills throughout the work, and the assistance of Mr. D. J. McCarthy in conducting tests which were made at the Potrero plant.

The A-B-C of Corrosion Resisting Steels

By F. R. Palmer

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WITH a new material, such as the stainless steels, manufactured by many different mills and under a variety of trade names, it is only natural that much published data should be contradictory, incomplete and even inaccurate. However, ten year's experience in the manufacture and use of these steels has added enormously to our knowledge of them, and it is now possible to derive some fundamentals which will greatly assist the consumer in investigating the metals themselves and their fields of application. Until our problem is reduced to an exact mathematical science, a certain amount of cutting-and-trying is inevitable, but meanwhile there is no reason why we should not use the fundamental data which is available.

There are dozens of brands of stainless steels made in this country today, but these can be accurately classified into three general groups to be designated as A, B, and C. The three groups have very little in common one with another and should no more be confused than should three totally different metals like German silver, bronze and Monel metal which all contain copper and all possess corrosion-resisting properties but which we are not tempted to classify under one head for application.

Each group is characterized by certain properties com-

mon to all steels falling in that group. The exact properties of individual steels will vary considerably depending upon the percentage of carbon and chromium—and to a lesser extent upon special additions such as manganese, silicon, copper, aluminum, tungsten and molybdenum. It does not therefore follow that all steels within a given group are interchangeable in their application, and we must still take cognizance of brand names and detailed analyses.

For the sake of simplicity the general properties of each group of stainless steels have been briefly tabulated below without an attempt to extend the table beyond the mere delineation of group characteristics. The detailed properties of any given steel should be secured from its manufacturer.

In the table, it should be noted under the head of "Analysis" that Group A has for its top limit about 14 per cent chromium, while Group B has for its lower limit about 16 per cent chromium. Steels containing from 14 to 16 per cent chromium partake of the properties of both groups. These group limits fluctuate somewhat, depending upon the other elements contained in the steel. For example, stainless iron containing about 0.10 per cent carbon may contain up to about 14 per cent chromium and still remain in Group A. When the carbon is raised to 0.30 per cent the chromium can be increased to 15 or even 16 per cent and the steel will still exhibit the properties of Group A. The introduction of high manganese or nickel will also tend to raise the chromium limits while the use of silicon or aluminum will tend to lower the chromium limits of Group A.

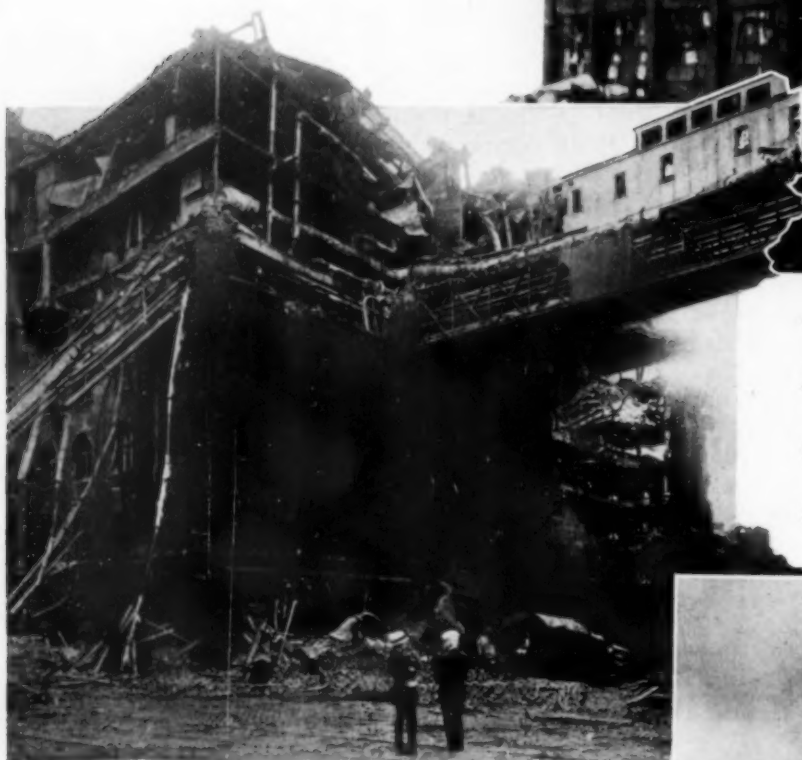
The A-B-C of Stainless Steels

	A	B	C
Analysis	Chromium less than about 14 per cent. Carbon less than about 0.4 per cent. May contain small percentages of tungsten, copper, nickel, silicon, molybdenum, etc. This group is magnetic.	Chromium more than about 16 per cent. Carbon less than about 0.4 per cent. May contain small percentages of copper, nickel, silicon, molybdenum, tungsten, etc. This group is magnetic.	Contain enough chromium and nickel to make steel austenitic and non-magnetic. Usually contain twice as much chromium as nickel or vice versa.
Heat Treatment	Respond to hardening, tempering, and drawing. Resulting physical properties depend on analysis.	Heat treatment not recommended. Naturally soft—usually having a Brinell hardness under 200 and seldom over 250.	Do not respond to heat treatment.
Toughness	Structurally dependable. Not brittle in sharp-notched sections or under impact.	Have low impact resistance especially in notched sections. Not dependable for bolts and similar notched parts when used under impact.	Extremely tough at all times. Thoroughly dependable for any type of shock service within the capacity of their strength.
Grain Growth	Not subject to excessive grain growth at incandescent temperatures. Thoroughly dependable at any temperature for supporting any load or shock within carrying capacity.	This group is divided with regard to grain growth. Simple chromium irons and those containing high silicon or aluminum subject to excessive and dangerous grain growth and become very brittle. Grain growth reduced by use of carbon, manganese, copper and nickel. Some steels containing these elements not subject to grain growth at all.	Do not become brittle due to grain growth—thoroughly dependable for high temperature service.
Hot Working Qualities	Readily forged, pierced or rolled. Air harden on cooling.	May be forged, rolled or pierced. Steels subject to grain growth must be heated very quickly. Those not subject to grain growth are heated in the usual way.	May be forged, rolled or pierced. Become work-hardened progressively below 1,800 deg. F. Do not air-harden.
Cold Working Qualities	Can be cold drawn into wire, cold rolled, bent, formed, upset, coined and deep drawn.	Can be cold drawn into wire, cold rolled, bent, formed, upset, coined and deep drawn. Not quite as easily worked as Group A with equal carbon content.	Can be cold drawn into wire, cold rolled, bent, formed, upset, coined and deep drawn. Work-harden twice as rapidly as Group (A).
Machining	Machine readily with properly designed tools.	Machine readily with properly designed tools.	Very difficult to machine. An outstanding objection to this group.
Riveting	Make excellent cold rivets. Not recommended for hot rivets driven above 1,500 deg. F. on account of air-hardening.	Due to low impact values, not desirable for either hot or cold rivets.	Excellent for either hot or cold rivets. Hot rivets may be driven at a high temperature.
Welding	Can be welded autogenously and by electric arc or resistance. Weld air-hardens. No grain growth.	Can be welded autogenously and by electric arc or resistance. Those metals subject to grain growth become very brittle adjacent to the weld. Those metals not subject to grain growth yield satisfactory welds.	Can be welded autogenously and by electric arc or resistance. Weld does not air-harden and is very tough. An excellent group for welded products.
Corrosion Resistance	Very satisfactory for resisting weather, water and many organic and inorganic corrodents.	Possesses corrosion resisting properties superior to group (A)	Corrosion resistance depends largely upon chromium content. This group will resist some types of action that groups (A) and (B) will not. With chromium over 16 per cent the resistance is excellent.
Scale Resistance	Useful for temperatures up to about 1,500 deg. F.	Superior to group (A)—recommended for temperatures about 1,500 deg. F.	The high chromium steels are as good or better than steels of equal chromium in group (B).
Strength at Elevated Temperatures	Much better than straight carbon steel for temperatures up to 1,000 deg. or 1,200 deg. F.	Steels subject to grain growth not safe at high temperatures.	Better than group (B) at temperatures over 1,000 deg. F.

*Typical Industrial
Plants
Laid Waste by
Dust Explosions*



Above—Explosion of pyroxylin dust in Detroit, where 28 lives were lost



Left—Results of an explosion of sugar dust in an eastern refinery

Below—Hard rubber dust blew the side out of this middle western plant

Bottom—Starch factory wrecked by an explosion of starch dust



Dust Menaces Industrial Plants

A recent survey of dust explosions reveals hazard in numerous chemical engineering industries

By David J. Price

Engineer-in-charge, Chemical Engineering Division, Bureau of Chemistry and Soils, U. S. Department of Agriculture

CONSIDERABLE attention has been given in recent years to dust explosions in industrial plants. The dust explosion research studies in the Bureau of Chemistry and Soils of the Department of Agriculture have been confined for the most part to grain handling or milling industries. In many instances, however, the Bureau has been called upon for assistance by many other types of industries in which dust explosions have occurred and in which protection was essential.

In order to secure data regarding the frequency of dust explosions, a special study has been made of representative types of chemical engineering industries. The results of this very limited survey are summarized in this article. They show that practically all industries in which combustible dusts are created during manufacturing operations are subject to dust explosions, and emphasize the need of additional research on this important industrial problem.

Pyroxylin Lacquer Dust. An explosion of pyroxylin lacquer dust in a Detroit plant last April has resulted in extensive inquiry regarding the possible dust explosion hazard in the chemical engineering industries. The company was engaged in the manufacture of

automobile bodies and painting operations in connection therewith. The explosion resulted in the loss of 28 lives and approximately \$4,500,000 property damage. Early reports of the explosion and fire indicated that the occurrence was due to the ignition of vapors and gases from the pyroxylin lacquers used in the paint spraying operations. A thorough study and investigation of this explosion has proved definitely that the explosion was caused by the ignition of pyroxylin lacquer dust. The investigators concluded that the fire or explosion originated either inside the auxiliary box around a mercury vapor electric lamp or from the ignition of the vaporized paint by static electricity.

Sulphur Crushing and Pulverizing. Eleven explosions of sulphur dust were studied. These explosions occurred in sulphur works, chemical plants, rubber factories, a paper plant,



An Explosion of Pyroxylin Lacquer Dust Started This Fire in a Detroit Factory, April 23, 1927

and a fertilizer plant. Seven of the explosions resulted from the ignition of sulphur dust by sparks produced in the operation of grinding and pulverizing machines, or in other types of operating equipment. The other four explosions were traced to sparks of static electricity igniting sulphur dust. These explosions caused considerable damage and resulted in injuries to 33 employees. They occurred in seven different states in the United States, and in one Province in Canada.

Rubber Recovery. Four explosions of hard rubber dust occurred in rubber recovery plants, and resulted in the loss of 8 lives and injuries to several workmen. Two of these explosions originated in the grinding and pulverizing machinery, one was caused by sparks from foreign material in a fan handling hard rubber dust, and the other originated in a cyclone dust collector.

Starch Manufacture. Sixteen explosions of starch dust were carefully studied. Three of these explosions originated in the grinding and pulverizing equipment, three originated in the drying machinery, three originated during the operation of conveyors and transporting equipment, three were traced to the use of open flame lamps, one was traced to the breaking of an electric lamp bulb, and one was ascribed to static electricity. The causes of two were undetermined. As a result of these explosions 115 lives were lost, and 91 people were injured.

Sugar Refining. Nine explosions of sugar dust were investigated. Five of these explosions occurred in pulverizing operations, two were caused by metallic sparks, and two by electrical sources of ignition. Twelve persons were killed and 24 injured as a result of these explosions.

Wood Working Plants. Twenty-seven explosions of wood dust were looked into. These explosions included wood dust, wood flour, lignone, wood pulp, and sawdust. The explosions were caused principally by fires, overheated bearings, and electrical sources of ignition. In these explosions 16 lives were lost, and 46 workmen were injured.

Cork Pulverizing. Six explosions of cork dust were studied. The principal cause of these explosions was found to be sparks from foreign material entering grinding and pulverizing machinery.

Metallic Dusts. Two explosions of aluminum dust were ascribed to metallic sparks, and one explosion to an electric arc. The cause of an explosion of zinc dust was not definitely determined. An explosion of magnesium powder was ascribed to sparks produced by friction in handling the packed boxes. An explosion of aluminum bronze powder occurred during the fighting of a fire in the plant. As a result of these

explosions, 14 people were killed and 26 were injured.

Fertilizing Plants. Six explosions in fertilizer plants were studied. All these explosions were caused by the presence of foreign material in grinding machinery.

Spice Plants. Three explosions of spice dust were observed. Two of these occurred in grinding operations, and the third during the progress of a fire. As a result of these explosions five persons were killed and fourteen were injured.

Pitch Grinding and Pulverizing. Two explosions of pitch dust were studied. One of these explosions occurred in connection with grinding and pulverizing operations: the other resulted from the breaking of an incandescent electric lamp bulb.

Rosin Handling. An explosion of rosin dust in a chemical plant was caused by the ignition of the dust by metallic sparks from a broken elevator chain. Three men were badly burned by the fire following the explosion.

Powdered Milk Plants. Two explosions of powdered milk dust are on record. Both these explosions originated in the drying equipment.

Chocolate and Cocoa Plants. Two explosions of chocolate and cocoa dust were traced to the ignition of the dust by sparks from foreign material passing through operating equipment. In one of these explosions three men were killed and one was injured.

Celluloid Plants. Two explosions, resulting in the death of five employees were investigated. Both explosions were traced to the ignition of the dust by metallic sparks produced in manufacturing operations.

Textile Plants. Three explosions of cotton dust are on record. All these explosions appeared to result from the presence of foreign material in operating equipment.

The survey discussed in this article covers a study of 97 dust explosions in 15 different lines of industry exclusive of the grain industries. The survey indicates the importance of extending dust explosion research to the chemical engineering industries.



In This Explosion of Starch Dust Forty-two Men Were Killed and the Packing House Completely Destroyed

New Vanadium Catalyst For Sulphuric Acid

By L. F. Nickell

Superintendent, Monsanto, Illinois Plant, Monsanto Chemical Works, St. Louis, Mo.

Much interest has lately centered in the search for an efficient substitute for the costly platinum catalyst used in sulphuric acid manufacture. The highly active vanadium silicate contact mass, which is now being used successfully on a commercial scale in this country, appears as an economical solution for the problem. Dr. Nickell advances the opinion that platinum catalysts for sulphuric acid will be abandoned within the next decade.

VANADIUM compounds as oxidizing catalysts find frequent mention in chemical literature during the past thirty years. As early as 1895 Johann J. Walter (*Journal Für praktische Chemie*, N. S., Vol. 51, page 108) proposes the use of vanadium catalysts for the vapor-phase oxidation of a number of organic compounds.

In 1899 R. Meyers (*Jahrbuch der Chemie* IX, *Jahrgang*, 1899, page 304) advocates the use of vanadic acid as a sulphuric-acid catalyst; and later (1900 and 1901), DeHaen obtained patents for such a process in Germany (D.R.P. 128,616), England (B.P. 8,545), and the United States (U.S. Patent 687,834). These patents describe the use of finely divided vanadic acid and soluble vanadium compounds deposited upon mineral carriers such as asbestos, pumice-stone, or other porous mineral substances. The DeHaen patents can be considered as basic in the art.

During the next decade, a number of other vanadium catalysts for sulphuric acid were developed and patented, among which may be mentioned the vanadium-platinum catalyst suggested by E. Petigout in 1902.

In 1913 a British patent (B.P. 15,174) describes the use of iron-vanadium compounds as catalysts for sulphuric acid, while other patents (B.P. 15,165, and U.S. Patent 1,102,670) advocate the use of silver-vanadium catalysts for sulphuric acid. No large scale use seems to have resulted from these discoveries, however, probably due to the low activity of the catalyst under actual manufacturing conditions.

In 1913 and 1914 the Badische Anilin and Soda Fabrik was granted patents in England (B.P. 23,541) and in Germany (D.R.P. 291,792). An application was also filed simultaneously in the United States, but the patent was not granted until 1921 (U.S. Patent 1,371,004). These patents describe the preparation and use of a sulphuric-acid catalyst made by impregnating a very finely ground, inert carrier with a solution of a salt of vanadic acid. The chief feature of these patents resides, apparently, in the fineness of the carrier particles, which are ground to a degree of fineness, such that the particles do not exceed 60 microns in diameter.

During the last few years there have been developed in our laboratories, new types of vanadium catalysts which are now in use successfully in a number of sulphuric acid plants. These catalysts have overcome, on

a manufacturing scale, the objections which previous vanadium catalysts have apparently encountered. These catalysts are covered by patent applications, some of which have already been granted in the United States and in foreign countries.

ESSENTIALLY, these new catalysts consist of complex vanadium silicates and give contact masses of high catalytic activity. The complex vanadium silicates can be used as such, or they can be diluted with various inert substances of any particle size. In either case, they exhibit an exceptionally high activity, showing conversions of SO_2 to SO_3 of 97 per cent to 98 per cent and even above, which conversions are maintained at usual commercial loading rates. The mass will even stand a large overloading.

Aside from greatly decreased cost as compared to platinum catalysts, the great advantage of these new catalysts in sulphuric-acid manufacture, lies in the fact that they are not poisoned by such substances as arsenic or hydrochloric acid, which impurities are frequently encountered in commercial sulphur dioxide gases, especially those from metallurgical roasters.

In the case of a platinum mass, the usual experience is that such poisons result in a gradual but continuous decrease in activity, with consequent increase in the manufacturing cost in sulphuric acid. The advantage of a contact catalyst which is not affected by such poisons, and which constantly gives a high conversion, is obvious; and such has been our experience with these new catalysts over extended periods of time.

With the exception of this marked advantage, the behavior of these new catalysts with respect to temperature, conversion equilibrium and activity, closely parallels that of the best platinum catalysts. It is believed that within the next decade the use of platinum catalysts for sulphuric acid will be entirely abandoned and the use of vanadium catalysts completely established in their stead.

Treatment of Chromium Plating Solution

Chromium plating solution is generally prepared from CrO_3 solution by its partial reduction or by the addition of $\text{Cr}(\text{OH})_3$. The CrO_3 solution is reduced by the electrolysis or by the addition of soluble reducing agents. Writing in the *Jour. Soc. of Chem. Ind. of Japan*, Yagoro Kato, Toru Kurakami and Sintaro Saito recommend treating the CrO_3 solution with insoluble organic colloids for this purpose.

In the plating, a film of chromic chromate is first formed on the surface of cathode. Its formation is explained as follows:—By the electrolysis, CrO_3 is reduced to $\text{Cr}(\text{OH})_3$, which forms this film when the concentration of the hydroxide becomes sufficiently high near the cathode. This was shown to be the case in the experiments.

From the results of ultrafiltration and diffusion experiments, it was confirmed that the chromic chromate solution is not colloidal. Freezing-point depression and electrical conductivity of the solution show that $\text{Cr}_2(\text{CrO}_4)_3$ resembles $\text{Cr}_2(\text{SO}_4)_3$ when dissolved in water. Consequently the condition throughout the plating solution is concluded to be an electrolytic one, and not due to cataphoresis, as is sometimes inferred.

Chemical Raw Materials for Dry-Cell Industry

By *A. D. Camp*

Buffalo, N. Y.

DRY CELLS first appeared in the United States about 1890, but it was several years later before reliable dry batteries were available in the American market. Since then the industry has grown very rapidly—largely because of the increasingly high quality of the product and the many uses to which it can be put.

The advent of the internal combustion engine, requiring a cheap and reliable source of ignition gave the first tremendous impetus to the development of dry batteries which had been used previously only for ringing doorbells, operating mechanical devices, and in the early telephones. The commercial development of storage batteries for automobile ignition threatened for a time to curtail the use of dry cells, but always new uses have been found to keep production on the increase. The World War, for example, greatly increased demand for dry cells for lighting and signalling purposes. When popular radio

started its phenomenal growth in 1921, the production of dry cells as essential accessories expanded to five times its normal size in as many years. In 1923 the U. S. Census reported the production of 221,859,834 dry cells with a value of \$18,903,269. Two years later the production had more than doubled. The \$37,238,607.

Many people now predict the speedy supplanting of radio dry batteries by light-socket power, but history is likely to repeat itself in the discovery of still wider uses for these handy little power plants. Furthermore, portable radio sets and the wide use of radio on farms and in outlying districts where electric current is not available, seem to assure a substantial continuance of the radio market.

Since dry-battery manufacture represents highly specialized practice, of interest to a relatively small number of plants, it will be the purpose of the present article to outline in some detail the raw material requirements for a typical unit in this industry. In Tables I and II are shown the approximate quantities and values of the raw materials required for a plant with an annual production of 48,000,000 miniature cells for flashlight and radio B and C batteries, and 1,500,000 cells of the so-called No. 6

cell for radio A ignition and general purpose batteries. The particular quality requirements, sources of supply, etc., are discussed for the chemical raw materials since they represent a substantial proportion of the output of several important chemical industries.

MANGANESE dioxide is probably the most important ingredient of dry cells and its purity and condition have a vital effect upon the quality of the finished product. Because it is a natural material purified only by mechanical processes, it is subject to wide variations depending upon its source and treatment. The principal types available are designated by the country of their origin and are listed as follows: Montana, Caucasian, African, Cuban, Porto Rican, Javanese, Brazilian and Japanese. These all differ in regard to chemical composition, physical condition and depolarizing power,

and in addition they will often differ from lot to lot, so that great care in the selection and application of this ingredient must be used.

Manganese dioxide is used in the positive electrode of dry cells because of its depolarizing quality or ability to oxidize hydrogen to water. The extent of this power in manganese dioxide from different sources appears to be independent of its MnO_2 content. For instance, Philipsburg manganese of 70 per cent MnO_2 is a better depolarizer than Caucasian ore containing 86 per cent MnO_2 . In different lots of the same type, however, the depolarizing quality is directly proportional to the MnO_2 content. The reason for this has never been definitely determined. The only way to find out is to try out the material in a standard mix formula in a dry battery.

The natural ore, pyrolusite, usually occurs mixed with other minerals such as silica, clay, limestone, iron oxide, tramp iron, copper, lead, arsenic, silver, cobalt, lower oxides of manganese, and probably other ingredients. Outside of its depolarizing power, the fitness of a given ore for battery use is dependent upon the quantity and kind of impurities present. The gangue minerals, which are those insoluble in boiling hydrochloric acid, are in-

noxious except as they dilute the active material. Ferric oxide up to three or four per cent as well as the lower oxides of manganese are also harmless, but metallic iron accidentally mixed in the ore is very deleterious and usually all shipments are passed over magnetic separators to assure its removal. The other metallic elements, particularly copper, lead and silver in any soluble form, are active poisons in a dry cell as they plate out on the zinc electrode and run the cell down by local short circuits. Their presence should be restricted therefore to mere traces, less than 0.02 per cent. Excessive lime causes gassing and low service.

Another quality of manganese dioxide that must be considered is the characteristic voltage which different types impart to cells. For instance the characteristic voltage of a miniature cell composed of Philipsburg manganese is 1.60 when fresh, while the corresponding voltage for Cuban manganese is 1.55. While this point is of insignificant importance in flashlight and No. 6 cells, it is very noticeable in radio "B" batteries where the public is trained to judge their quality by the voltage.

There is a considerable variation in the cost of manganese dioxide for battery use. Philipsburg besides being the best depolarizer is also the cheapest. The contract quotation February, 1928, for ground domestic ore averaging 70 to 72 per cent MnO_2 was \$50 to \$55 per short ton at the mine, which means about \$60 to \$65 at the Atlantic Seaboard. Other types, Caucasian, Cuban, African and Porto Rican in the same condition run from \$70 to \$85 per ton f.o.b. docks Philadelphia or New York. With Philipsburg ore in its original high state of purity, no experienced battery manufacturer would consider using anything else, but on account of its depreciating quality and availability during the past few years, Caucasian and Cuban ores are again being used.

Up to about eight years ago artificial manganese dioxide at a high price found a considerable use in miniature cells but exhaustive tests showed it to be inferior in regard to shelf life and intermittent service, and its use is not considered practical at the present time.

Specifications must be drawn separately for each variety of manganese dioxide.

GRAPHITE, an important mix material, may be dismissed in a very few words since Acheson artificial graphite is so far superior to practically all natural graphites that there is no question of which to use. It has been the writer's experience that the cheapest grades of artificial graphite are superior to any other variety no matter how expensive. The artificial graphites are lower priced than most of the natural products and the only question, therefore, is which grade should be used. With

the "milled mixing" method of manufacture the Acheson No. 500 and 697 can be used with equal success. With ordinary methods of mixing a certain proportion of finer grades should be used for the best results.

Sal amoniac—This is the most important of the electrolyte materials. The usual white powdered commercial grade is used and it should contain less than 1 per cent of ash or non-volatile residue and under 0.75 per cent moisture. The best material obtainable is of domestic manufacture, but the imported sal amoniac coming largely from Germany, is considerably cheaper and it is usually satisfactory for use.

Zinc chloride—Fused or granular zinc chloride is usu-

Table II—Raw Materials for Manufacture of No. 6 Dry Cells

Material	Amount per M. Cells	Unit Cost	Amount for 1,500,000 Cells	Total Cost
Manganese Dioxide.....	800 lb.	\$70.00 per ton	600 tons	\$42,000
Graphite.....	315 lb.	.07 per lb.	432,500 lb.	30,280
Sal Ammoniac.....	135 lb.	.07 per lb.	202,500 lb.	14,175
Zinc Chloride.....	70 lb.	.085 per lb.	105,000 lb.	8,920
Mercuric Chloride.....	.05 lb.	1.31 per lb.	75 lb.	100
Wheat Flour.....	1.0 lb.	.05 per lb.	1,500 lb.	80
.020" Pulp Board Liners.....	1,000 pc. (38 lb.)	2.00 per M. (.074 per lb.)	1,500,000 pes.	3,000
.020 Pulp Board Discs.....	3,000 pes.	.80 per M.	4,500,000 pes.	3,600
Zinc Cans Complete	1,000 pes.	27.00 per M.	1,500,000 pes.	40,500
Solder for Terminals	.4 lb.	.32 per lb.	376 lb.	120
Soldering Flux.....	1 lb.	.04 per lb.	148 lb.	8
Carbon Electrodes.....	1,000 pes.	21.50 per M.	1,500,000 pes.	32,252
Brass Caps with Posts.....	1,000 pes.	4.80 per M.	1,500,000 pes.	7,200
Screw Post Terminals.....	1,000 pes.	.90 per M.	1,500,000 pes.	1,348
Knurled Nuts.....	2,000 pes.	1.68 per M.	3,000,000 pes.	5,040
Sand.....	5 lb.	.02 per lb.	7,500 lb.	112
Coal Tar Pitch.....	40 lb.	.015 per lb.	600,000 lb.	900
Rosin Sealing Wax.....	45 lb.	.045 per lb.	67,500 lb.	3,040
Jackets Tubular.....	1,000 pes.	11.00 per M.	1,500,000 pes.	16,500
Shipping cartons.....	40 pes.	2.00 per M.	600,000 pes.	12,000
Total.....				\$221,175

ally packed in light-weight steel drums, and either form may be used by the battery manufacturer, depending upon the solution arrangements in the factory. Both are of about equal purity when obtained from the same source, but the granular variety is usually about $\frac{1}{4}$ c. per pound dearer. The most reliable producers are found in this country, but much German zinc chloride is offered to the battery trade at considerably lower prices than the domestic. It is rarely pure enough for use, however, often being heavily contaminated with traces of heavy metal impurities. The only other important requirement is that the alkali chloride content shall be less than 1 per cent.

Mercuric chloride.—Small amounts of this chemical are dissolved in the electrolyte for the purpose of slightly amalgamating the inside surface of the zinc can, in order to minimize the effect of any harmful metallic impurities in the mix and to give a slightly higher voltage. High-grade material is easily obtainable in this country.

It has been found that a blended wheat flour similar to the regular household brands makes the best dry-cell electrolytic paste. Potato starch is often mixed with wheat flour in the ratio of 1 to 2 in order to obtain a certain consistency for the paste, but this is not absolutely necessary. The imported Dutch and Japanese varieties of potato starch are most used.

No attempt has been made in this article to cite exact specifications for raw materials nor the approved methods of testing them. These are, however, important if not essential considerations in dry-battery manufacture. Fortunately, adequate specifications are available from a number of responsible sources and these offer a common meeting ground for the producer and consumer of the chemical raw materials used in the dry-battery industry.

Table I—Raw Materials for the Manufacture of Miniature Dry Cells

Material	Amount per M Cells	Unit Cost	Amount for 48,000,000 Cells	Total Cost
Manganese Dioxide.....	57.0 lb.	\$70.00 per ton	1,368 tons	\$95,760
Graphite.....	19.0 lb.	.07 per lb.	912,000 lb.	63,840
Sal Ammoniac.....	17.0 lb.	.06 per lb.	816,000 lb.	48,960
Zinc Chloride.....	5.0 lb.	.07 per lb.	240,000 lb.	16,800
Mercuric Chloride.....	0.05 lb.	1.31 per lb.	2,400 lb.	3,144
Wheat Flour.....	5.75 lb.	.05 per lb.	276,000 lb.	13,800
Potato Starch.....	2.8 lb.	.065 per lb.	134,400 lb.	8,736
Muslin Wrappers.....	1,000 pc. (9.17 yds.)	1.25 per M. (.136 per yd.)	465,600 yds.	60,000
Thread.....	.5 lb.	1.20 per lb.	14,400 lb.	17,280
Carbon Electrodes.....	1,000 pc.	1.70 per M.	48,000,000 pc.	81,600
Brass Caps.....	1,000 pc.	.40 per M.	48,000,000 pc.	19,200
Rosin Sealing Wax.....	15 lb.	.055 per lb.	720,000 lb.	39,600
Zinc Caps Complete	1,000 pes.	6.00 per M.	48,000,000 pc.	288,000
.025 Jute Board for Bottoms.....	1,000 pes.	.005 per M.	48,000,000 pc.	240
.040 Pulp Board for Washers.....	1,000 pes.	.005 per M.	48,000,000 pc.	240
Total.....				\$757,200

The Catalytic Oxidation of Oils on a Commercial Scale

By W. P. Bitler and J. H. James

THE PLANT here described is, to the authors' knowledge, the first commercial scale plant for the oxidation of petroleum in the vapor stage that has been operated successfully. The work opens up a wide field for investigation such as varying the nature of the product by changes in the catalytic material, chemical treatment of the oxidized oil to form more usable products, and developing uses for these new products.

The plant has a capacity of approximately 4,000 gallons of kerosene per day. It can also handle higher boiling fractions such as gas oil and spindle oil. So far the condensing equipment has not been made elaborate enough to handle distillates of lower boiling point than kerosene.

The oxidation is carried on in four identical units, each handling 40 gallons of kerosene per hour. The oil first passes through a Venturi type meter with a block tin throat. From the flow-meter the oil passes into a Foster oil heater which in this case is really a tube still. Here the oil is completely vaporized and superheated to between 350 and 375 deg. C. In the case of heavy distillates steam is admitted to complete the vaporization at this temperature. From the vaporizer the oil passes to the oxidizer, or to prevent the oxidizer from being flooded during heating up it may be bypassed directly to the condenser.

OUR oxidizer is made up almost entirely of standard six-inch pipe and fittings as shown in the drawing. The nipples between the screens do not present sufficient cooling surface to dissipate the heat of oxidation, so these were equipped with spiral fins. C is a casting which holds the catalyst screen in place. A 1-in. valve admits air for the oxidation, the air passing well back into the nipple so that it becomes thoroughly mixed with the oil vapors before passing the catalyst screen. The amount of air admitted is regulated to give a temperature to the vapors after passing the screen of 410 deg. C. If more air is admitted the temperature increases and excessive carbon dioxide formation is observed. Up to this temperature the loss to carbon dioxide does not increase rapidly. With a good catalyst, the oxidation reaction begins as low as 225 deg. C. In practice the oxidizer is preheated by gas to 250 deg. C. and the oil vapors admitted. In four to five minutes the reaction will heat the whole oxidizer to operating temperature. The finned nipples cool the vapors again to 350 deg. and the heat of reaction again brings them back to 410 deg. C. The oxidizers were built for six screens but it was found necessary to use only four. As far as the catalyst is concerned, cooling between screens could be carried further and more reaction per screen obtained, but the oil vapors

would tend to condense at this lower temperature and foul the screens.

The oil vapors and the nitrogen from the air then pass through a tank equipped with a sort of reflux condenser made by water jacketing a 6-inch pipe, 8 feet long. In this tank most of the heavy tars (polymerization products of the unsaturated oxidized bodies) which would foul the condensers are removed.

THE vapors then pass to a tubular condenser. The tubes and tube sheets are of aluminum as this seems to withstand best the corrosive action of the organic acids produced. Four hundred 5-foot tubes $\frac{3}{4}$ in. (outside diameter) are used, giving a cooling surface of approximately 330 sq.ft. This large surface is made necessary owing to the high partial pressure of nitrogen in the vapor mixture. The tars that are not caught in the reflux tube foul the condenser so that it must be cleaned with steam or compressed air about once every two weeks of continuous running. The chief difficulty with this type of condenser seems to be in the low elasticity of aluminum. While the floating head type of construction is used to take up longitudinal expansion the tube gets hotter than the tube sheet, and on cooling loosens up slightly, making frequent re-expanding necessary. With steel or brass the elasticity of the metal springs the tube tight on cooling.

The condensed vapors then pass to a central receiving tank for all four units. There is a bypassing trap in each line for taking samples during the run. The increase in specific gravity of the oil is a rough measure of the per cent of changed molecules in the oil.

The main receiving tank is maintained under a 15-in. vacuum by two No. 3 Nash Hytor vacuum pumps. The amount of air consumed is about 160 cu.ft. per minute per unit at atmospheric pressure.

The uncondensed vapors and nitrogen contain considerable quantities of formic acid, rendering water a poor cooling medium and seal for the pumps. Hence oxidized oil is used for sealing and as a cooling medium. It is trapped from the exhaust gases, passed through a tubular oil cooler and returned to the pumps by their own suction.

From the main receiving tank the oil is pumped to a settling tank with a $1\frac{1}{2}$ -in. Viking pump. This pump gives good service pumping against the 15-in. vacuum in the tank. The settling tank is a large vertical tank 12 ft. high and 6 ft. in diameter. It takes about one hour to settle out the water formed in the oxidation. This is drawn off and the oil pumped to a storage tank for further treatment.

AT PRESENT, the plant is running on a Pennsylvania kerosene and the oxidized product is the material from which the alcohol denaturant known as Aldehol is prepared.

The water contains sufficient formaldehyde to warrant its recovery as hexamethylenetetramine. It also contains soluble acids, the recovery of which has not been investigated.

As showing the possibilities of this process, we have demonstrated that by oxidizing three cuts, naphtha, kerosene, and wax distillate, we can prepare nitrocellulose solvents distilling through the whole range of low boilers, medium boilers, high boilers, plasticizers and softeners. These solvents are mixtures of inner esters, ordinary esters, alcohols and ethers. Aldehydes and ketones are present in the unpurified products, but these will probably be removed in preparing the finished lacquer solvents.

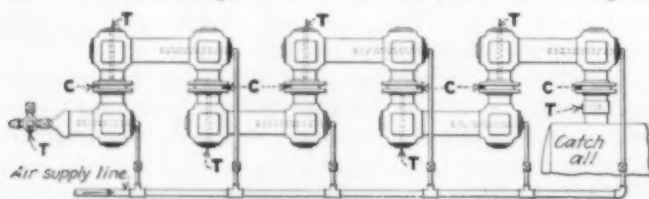


Diagram of Oxidizer Showing Position of Air Inlets, Catalyst C and Pyrometer Wells T

From a paper presented at the meeting of the American Institute of Chemical Engineers, St. Louis, Dec. 5-8, 1927.

Calculation Shows Minimum Surface for Evaporators

By Bo Höglund

Cuba Cane Sugar Corporation, Moron, Cuba

THE following calculations, worked out for multiple-effect evaporators used in the production of beet sugar, are applicable wherever it is desired to calculate the minimum heating surface in a multiple-effect evaporator required to evaporate a given weight of water. It is assumed that the number of effects used is known, as is the weight of water to be evaporated in each, and the total temperature drop through the system. The problem, then, is to so distribute the temperature drop among the several effects that the total heating surface may be a minimum.

The apparent heat transfer coefficient in each effect is known, approximately, and will be represented by k (cal. per kg.). The available heat of vaporization per unit of steam is taken as constant throughout the system and is represented by r (cal. per kg.). The required heating surface will be calculated in terms of the consumption of raw material.

Raw material worked P (metric tons per 24 hr.)

Apparent temperature drop from steam chamber to juice chamber t (deg. C.)

Heat transfer coefficient k (cal. per kg.)

Water evaporated in each effect d (kg. per 100 kg. of raw material.)

Heat surface in one effect F (sq. m.)

Available heat of vaporization r (cal. per kg.)

Total distributable temperature drop T (deg. C.)

Subscripts denote the number of the effect.

The total distributable temperature drop T is equal to the total difference in condensing temperature between the steam entering the first effect and the vapor in the last effect, minus the total temperature drops of the steam in passing from one effect to the next. The value of d does not include the self-evaporation which may be approximated and deducted from the desired evaporation in each effect per 100 kg. of raw material in order to properly evaluate d .

For any one effect, the following equation holds:

$$F = \frac{10Pd}{24.60} \cdot \frac{r}{tk}$$

$$\text{or, } F = P \cdot \alpha \cdot \frac{\beta}{t}$$

$$\text{where } \alpha = \frac{10r}{24.60} \text{ (constant)}$$

$$\beta = \frac{d}{k} \text{ (known for each effect)}$$

Let n = number of effects

Then,

$$F_1 = P\alpha \frac{\beta_1}{t_1} \quad F_2 = P\alpha \frac{\beta_2}{t_2} \quad F_n = P\alpha \frac{\beta_n}{t_n}$$

And the total surface for all effects will be

$$\Sigma F = P\alpha \Sigma \frac{\beta}{t}$$

ΣF will be a minimum when $\Sigma \frac{\beta}{t}$ is a minimum.

Designate the quantity $\Sigma \frac{\beta}{t}$ as Z . Then,

$$Z = \frac{\beta_1}{t_1} + \frac{\beta_2}{t_2} + \dots + \frac{\beta_n}{t_n} \quad (1a)$$

$$T = t_1 + t_2 + \dots + t_n \quad (1b)$$

The values of t must be such that Z remains a minimum. If t_1 is taken as a dependent variable and partially derived with reference to $t_2, t_3 \dots t_n$, we obtain

$$\left. \begin{aligned} \frac{\delta Z}{\delta t_2} &= -\frac{\beta_1}{t_1^2} \frac{\delta t_1}{\delta t_2} - \frac{\beta_2}{t_2^2} \\ \frac{\delta Z}{\delta t_3} &= -\frac{\beta_1}{t_1^2} \frac{\delta t_1}{\delta t_3} - \frac{\beta_3}{t_3^2} \\ \frac{\delta Z}{\delta t_n} &= -\frac{\beta_1}{t_1^2} \frac{\delta t_1}{\delta t_n} - \frac{\beta_n}{t_n^2} \end{aligned} \right\} \quad (2a)$$

The equation (1b) is partially derived:

$$0 = \frac{\delta t_1}{\delta t_2} + 1$$

$$0 = \frac{\delta t_1}{\delta t_3} + 1$$

$$0 = \frac{\delta t_1}{\delta t_n} + 1$$

We obtain from equation (2b)

$$\frac{\delta t_1}{\delta t_2} = \frac{\delta t_1}{\delta t_3} = \dots = \frac{\delta t_1}{\delta t_n} = -1$$

This is inserted in the equation (2a) which, in order to obtain minimum equations = 0. Therefore:

$$\frac{\beta_1}{t_1^2} = \frac{\beta_2}{t_2^2} = \frac{\beta_3}{t_3^2} = \dots = \frac{\beta_n}{t_n^2} \quad (3)$$

The equations (3) give the conditions for minimum of Z . Solving, we obtain,

$$\left. \begin{aligned} t_2 &= \sqrt{\frac{\beta_2}{\beta_1}} \cdot t_1 \\ t_3 &= \sqrt{\frac{\beta_3}{\beta_1}} \cdot t_1 \\ t_n &= \sqrt{\frac{\beta_n}{\beta_1}} \cdot t_1 \end{aligned} \right\} \quad (4)$$

The equations (4) are inserted in (1b)

$$T = t_1 + \sqrt{\frac{\beta_2}{\beta_1}} \cdot t_1 + \sqrt{\frac{\beta_3}{\beta_1}} \cdot t_1 + \dots + \sqrt{\frac{\beta_n}{\beta_1}} \cdot t_1$$

This will give the solution and the desired temperature drops in each effect and consequently the temperatures in the whole system.

$$\left. \begin{aligned} t_1 &= \frac{\sqrt{\beta_1}}{\Sigma \sqrt{\beta}} \cdot T \\ t_2 &= \frac{\sqrt{\beta_2}}{\Sigma \sqrt{\beta}} \cdot T \\ t_n &= \frac{\sqrt{\beta_n}}{\Sigma \sqrt{\beta}} \cdot T \end{aligned} \right\} \quad (5)$$

In the beginning of this calculation the heat transfer coefficients were assumed. As these coefficients are dependent upon the temperatures, they should now be adjusted to satisfy the equations (5). Adjustment of the coefficients obviously affects the different values of β .

Now, by inserting these temperatures in equation (1a) we obtain the minimum required total heating surface.

$$\Sigma F = P \cdot \alpha \cdot \frac{(\Sigma \sqrt{\beta})^2}{T} \text{ sq.m.} \quad (6)$$

This calculation will not be affected if steam is introduced to an effect other than the first, provided that this steam is saturated and of the same pressure as the steam with which it is mixed. Compensation for extra steam was made above in the evaluation of d .

Worth-While Economies in Producing Chlorine and Caustic Soda

Vorce cylindrical cell saves floor space and reduces installation and operating costs in largest peace-time chlorine plant

By *Sidney D. Kirkpatrick*

Associate Editor, Chem. & Met.

TEN YEARS ago when the United States Government approved the plans to build a 100-ton per day chlorine plant at Edgewood Arsenal, very few men in the alkali industry would have wagered that this imposing output would ever be exceeded by a single industrial plant engaged in peace-time production. Yet developments since the war promise just such results in the plant of Westvaco Chlorine Products, Inc., in South Charleston, W. Va. In order to supply the local requirements of a fast-growing organic chemical industry and the demand elsewhere for chlorine and its products, the Westvaco plant, already one of the larger chlorine producers of the country, is now adding 2,240 cells which alone will have a capacity in excess of 60 tons per day.

The economic and engineering considerations that governed the choice of the cylindrical cell are of unusual interest to the chemical engineer. Worth-while economies have already resulted both in the construction and in the operation of the new cell room. Lower installation costs were due primarily to the simplicity of the

Vorce cell, to the fact that it could be entirely constructed within the plant and to its unique saving in floor space. At Edgewood Arsenal, 1,776 cells (one-half of the total installation) are housed in a cell room 541 ft. x 82 ft. so that the working space per cell is 25 sq.ft. At Westvaco the 2,240 cells will actually occupy a space 205 ft. x 160 ft. This is equivalent to 14.7 sq.ft. per cell or a saving in floor space of approximately 40 per cent. The fact that

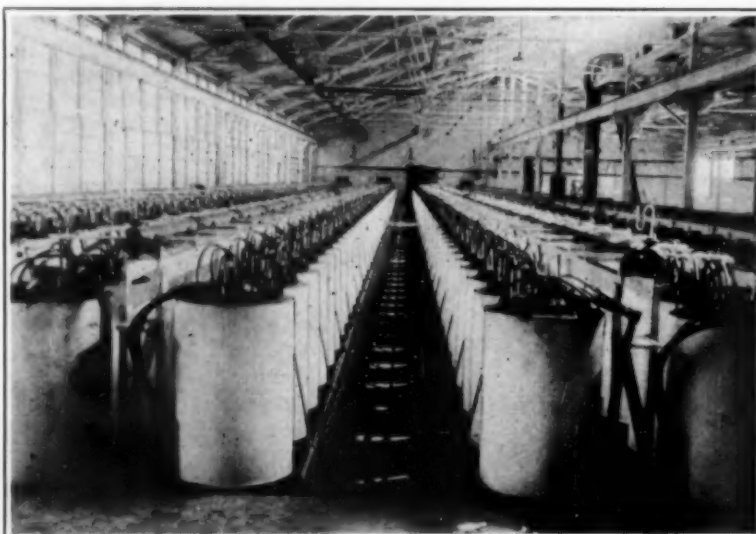


Fig. 1—A View Down One of the Aisles of the New Cell-Room at Westvaco. This bay of 560 Vorce cells was the first of four to be completed and put into commercial operation at the South Charleston Plant.

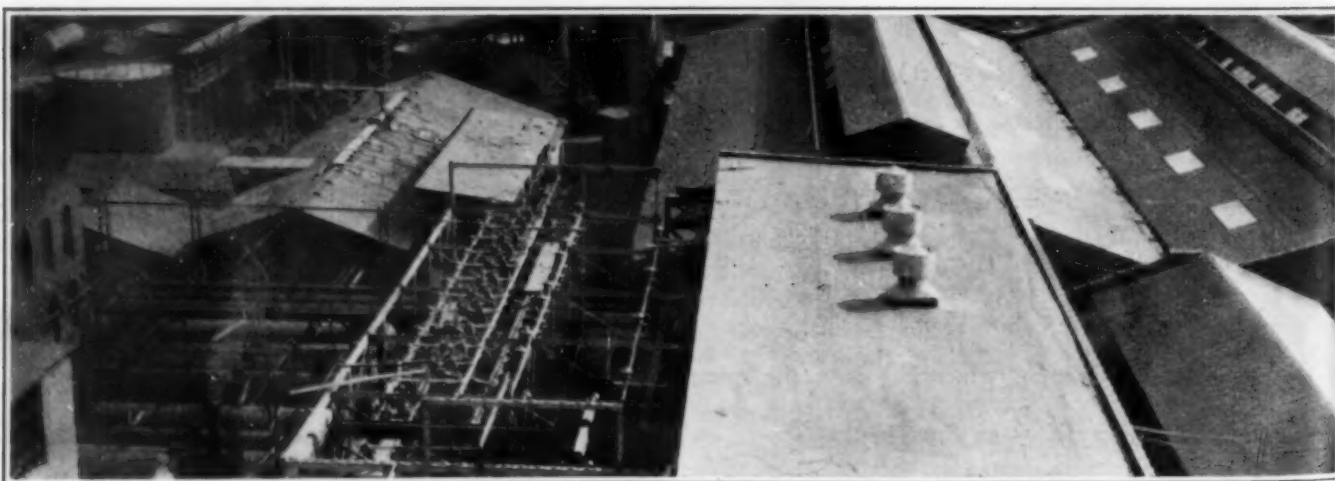


Fig. 2—General View of the New Chlorine Plant at South Charleston, W. Va. The new cell room is the building in the background at the purification area is at the left and the electric substation is right with the two monitors in its roof. The brine mixing and in the immediate foreground of this picture.

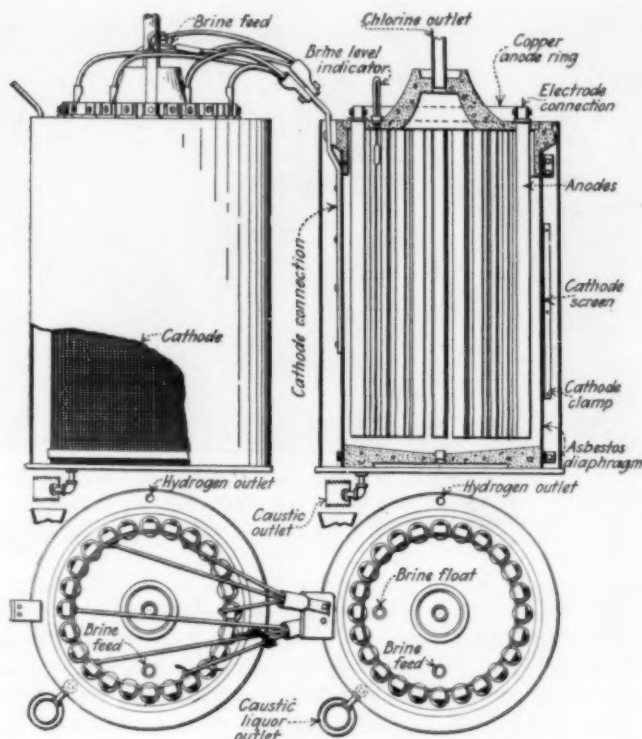


Fig. 3—Elevation, Cross-Section and Plan Views of Vorce Cylindrical Cell

the Vorce cell is placed on supports above the regular floor of the building also makes it possible to run all pipe lines in the open. Hence they are not only more accessible but expensive underground trenches are avoided and full advantage can be taken of the gravity flow.

Exceptionally low operating costs result from the high current efficiency of the cell and the fact that it can be serviced with a minimum of labor. In an 8-hr. day 6 men are able to handle replacements and maintenance for the entire installation. Two men can remove and replace 35 cells per day. Another dismantles and washes the cells while two men are engaged in re-wrapping the cathodes with new diaphragms. The sixth man reassembles the cells for replacement in the circuit. This is to be contrasted with manual operation in the old plant where four men are employed to rebuild four cells in two 8-hr. days.

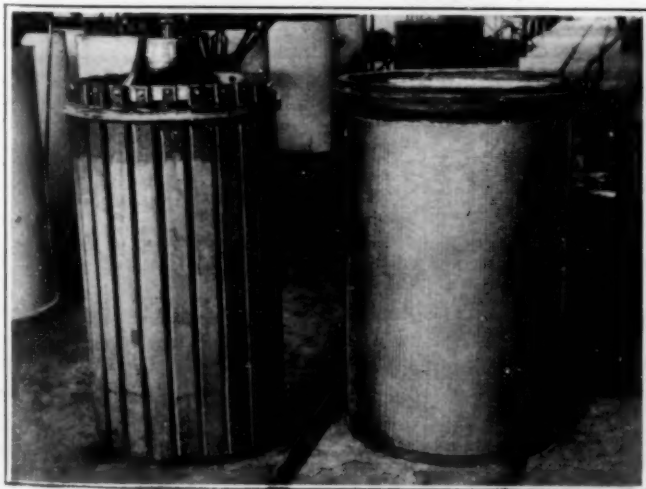


Fig. 4—Anode and Cathode Assemblies of the Vorce Cell

The method of attaching the Acheson graphite electrodes to the anode ring is seen at the left. The assembly at the right shows the iron cathode screen and the cathode connecting bar.

Table I—Average Results of Monthly Test Runs Made on Vorce Cells at Westvaco Chlorine Products, Inc., September 1, 1927—January 1, 1928

Specific gravity of liquor.....	1.211
Percentage of NaOH.....	8.607
Percentage of NaCl.....	15.79
Percentage of Na ₂ CO ₃.....	.115
Percentage of NaClO.....	Trace
Percentage of NaClO ₂.....	.068
Percentage of Cl in gas.....	98.3
Percentage of CO ₂.....	.7
Gallons of liquor per cell per hour.....	3.417
Pounds of caustic per cell per day.....	71.42
Pounds of chlorine per cell per day.....	63.15
Pounds of caustic per kw.-hr.....	.859
Pounds of chlorine per kw.-hr.....	.793
Pounds of caustic per kw. day.....	21.42
Pounds of chlorine per kw. day.....	19.08
Average amperes per cell.....	948.1
Average volts per cell.....	3.5
Temperature of brine, deg. F.....	147
Current efficiency (per cent).....	94.84
Power efficiency (per cent).....	62.11

As in most successful chemical-engineering developments this large-scale and efficient production of chlorine and caustic soda was preceded by exhaustive preliminary investigation. L. D. Vorce, chemical engineer of Montclair, N. J., joined the Westvaco company as a consultant in January, 1927, and at that time put in four test cells of the most modern cylindrical type. These were connected in series with the existing installation and daily records were kept of their operation over a period of three months. During this time they showed an average current efficiency of 97.01 per cent. Operating at an average voltage of 3.49 with average amperage of 943, their power efficiency was 64.6 per cent. The average NaOH content of the effluent was 103 grams per liter.

On the basis of this demonstration and the comparative results of other studies, the contract was let for 2,240 cells to be arranged in 32 series of 70 cells each. When the writer visited the plant (Feb. 17, 1928) 1,120 of the Vorce cells were in operation, the third bay of eight series (560 cells) had been installed and would shortly be in circuit, and work was under way to complete the entire installation within the next few months.

Since commercial operation began on September 1, 1927, 24-hr. test runs have been made each month on all of the cells and the average results are given in Table I.

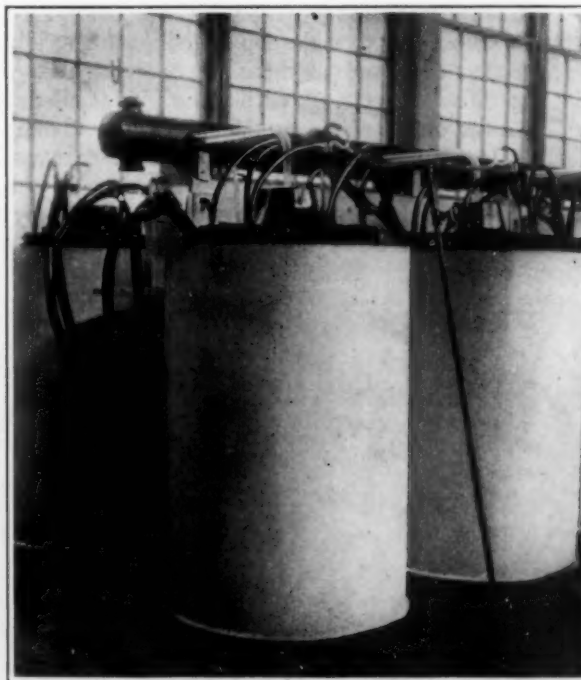


Fig. 5—End Cells in Series Showing Feeder Connections to Anode and Cathode

Details of the brine feed, level indicator and the chlorine outlet may also be seen in this picture.



Fig. 6—Wooden Form for Wrapping Diaphragm

Removable staves fit on the hexagonal drum shown at the left which then becomes the form on which the asbestos paper diaphragm is wrapped. Two men can re-wrap the diaphragms and attach the cathodes to 35 cells in an 8-hr. day.



Fig. 7—Concrete Supports for Cylindrical Cells

These were made by a local concrete-sewer tile manufacturer at a considerable saving. In addition to supporting the cells they carry timber joists to support the plank walk-ways between the cells.

THE new cell building for the augmented plant at South Charleston is a model of chemical plant construction. It was designed and built by the H. K. Ferguson Company, engineers of Cleveland, Ohio. This building is of structural steel framework with brick walls and wooden sash. The roof is covered with corrugated, galvanized steel painted inside and out with mill white. Two monitors and skylights placed at frequent intervals help to provide an exceptionally well lighted building. It is testimony to good ventilation as well as to efficient plant operation that the atmosphere of the cell house is entirely free from chlorine.

Construction of the Vorce cell may be observed from the cross-sectional and plan drawings in Fig. 3 and the photograph of the cathode and anode assemblies shown in Fig. 4. Over-all dimensions of the cell are 26 in. in diameter and 42 in. in height. The cathode pot is 21½ in. in diameter and the steel container tank is 38 in. high. In building the Vorce cell three concrete rings or sections of special composition are cast in iron molds under pressure. Ground asbestos is used with the portland cement in the mix, in order to make the rings light in weight and their circular design gives them ample strength for their purpose. The upper ring, or dome as it is called, holds the 24 Acheson graphite anodes which are about 2 in. square in cross-section. The ends of these carbons have been machined and threaded so that they extend through the concrete ring and are securely fastened to it by hard rubber nuts. The carbons are then bolted directly to the copper anode ring. Thus there is no joint in the carbon

within the cell. The carbons may be readily replaced although experience at Westvaco and elsewhere has demonstrated that with proper care the anodes will last about a year. The weight of graphite in each anode assembly is 203 lb. The cathode consists of steel wire screen and inside of it is the diaphragm of long-fiber asbestos paper.

In assembling the Vorce cell use is made of a novel wooden barrel-shaped form shown dismantled in Fig. 6. Two men working here re-wrap approximately 35 cells a day. The diaphragm is first wrapped on this form and the cathode screen is slipped over it after the upper and lower concrete rings have been fitted into position. The cathode is then securely clamped and the completed cathode assembly is removed from the wooden form. By use of a small overhead crane, the anode and cathode are placed in the container tanks which are made of steel with welded bottoms. The anode is sealed into place by means of asbestos rope and a special chlorine-resisting putty.

The brine is fed to the cell from a receiving tank which provides a constant head of 14 in. An ingenious glass device, which is a modification of that developed by Pritchard at the plant of the United Alkali Works in England, controls the actual flow of the brine into the cell. The construction of this device is shown in Fig. 8. Caustic liquor discharges from the cathode pot through a small cup-shaped device that breaks it into drops as the liquor flows over the serrated edges of the cup. Falling into a receiving funnel the caustic liquor passes through a 2-in. run-down line to the 6-in. cast-iron collecting mains in which it flows by gravity to the evaporator house.

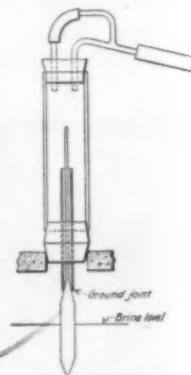


Fig. 8—Device for Feeding Brine and Controlling Level in Cell

The Vorce cells are placed in rows on 32-in. centers with 40-in. centers between the double lines. The cells are supported upon concrete cylinders similar to ordinary sewer pipes from which the cell is insulated by a small piece of asbestos felt that effectively prevents grounding of the circuit. These supports were made by a local concrete pipe manufacturer at a considerable saving. It was also possible to form in the side of these a support for a 3-in. x 6-in. timber joist which holds the plank walkway

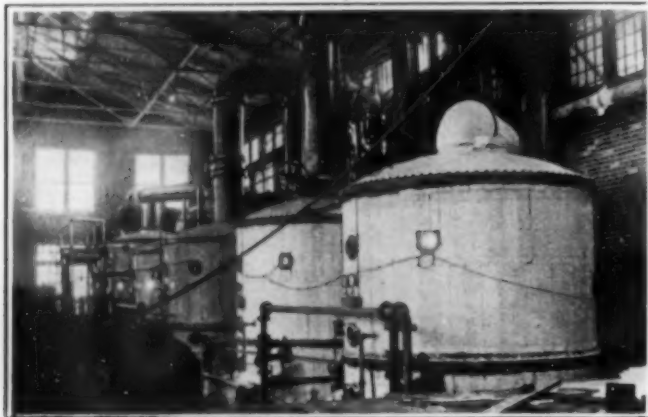


Fig. 9—Double Effect Zarembo Evaporators for Caustic Soda and Brine Concentration

at the level of the bottom of the cell, without the use of additional posts to the concrete floor below. This plank walkway is made in sections which can be readily lifted out from the supporting joist when it is necessary to get at the various pipes below the cells.

The chlorine is withdrawn from the dome of the cells through a glass connection fitting securely into the 4-in. stoneware collection mains that serve each series of 70 cells. A slight tension is maintained in this line by the Nash Hytor pumps of the chlorine cooling and collecting system. Downpipes from the 4-in. mains are connected to 6-in. and 8-in. stoneware pipes that carry the chlorine to the cooling coils which are also of stoneware. After passing through these coils the chlorine is dried by passing it against 66-deg. sulphuric acid in two stoneware towers 32½ ft. in height and 36 in. in inside diameter. A part of the dry chlorine gas, after passing through the sulphuric acid separating tank, is used in the plant for the production of chlorine products. The remainder is pumped under pressure by the Nash Hytors to the chlorine liquefying building or directly to the nearby plant of the chlorine consumer.

The hydrogen gas, collected from the outlets of the cells, is piped to an adjoining plant where it is consumed in chemical manufacture.

Six double-effect evaporators are used to concentrate the dilute caustic liquor in the evaporator house. A seventh of the same type is used to produce salt from the brine obtained from 940-ft. wells on the company's own property. A view of the evaporator house is shown in Fig. 9. Under normal operating conditions, a considerable portion of the caustic soda is sold as strong liquor which is pumped to the plant of a nearby consumer. This is concentrated to 48 deg. Bé. (about 46 per cent NaOH) and then cut back to a specific gravity of 1.295 (33 deg. Bé.) in order to prevent trouble from freezing. Solid caustic soda containing less than 1.2 per cent of

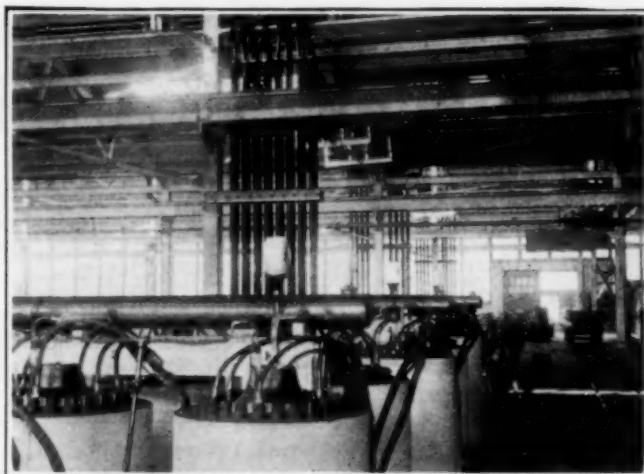


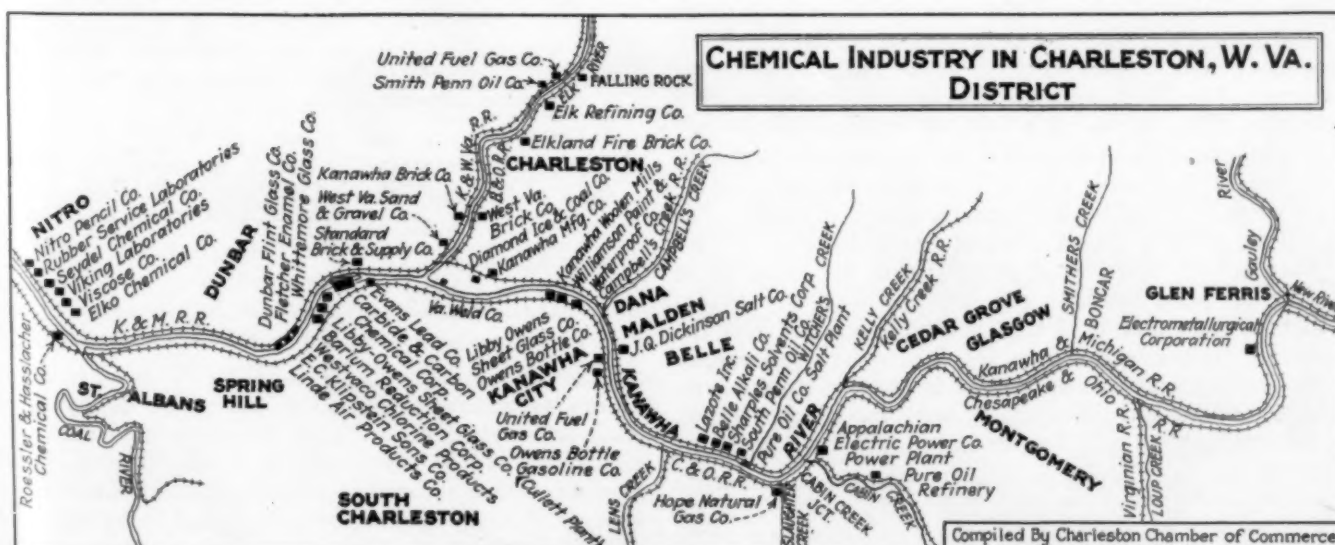
Fig. 10—Cell Banks from Working Platform at End of Cell Room
The method of bringing in the copper rod distribution feeders and the primary anode connection to the series is shown here.

then pumped to the finished brine tanks where sufficient HCl is added to cut down the excess of NaOH. As sent to the cells, it is desirable that the brine be neutral or only slightly alkaline.

The power plant of Westvaco Chlorine Products, Inc., is unique in a number of respects. The rotary converter station that furnishes the current for operating the cell installation is one of the largest of its kind ever built here. It consists of four Allis-Chalmers 3,250 kva. synchronous converters running at 187 volts on the A.C. side, and 250 volts on the D.C. side. In addition, there is a turbo-generator which operates non-condensing, its exhaust furnishing the process steam requirements of the plant.

The cells are operated at 1,000 amp., and 250 volts for each series of 70 cells. The distribution feeders were especially designed by the Ferguson company in collaboration with plant engineers, in order to give a uniform voltage drop at the cell terminals. These distribution feeders are bare, round copper rods varying from 1 in. to 1½ in. in diameter.

For much of the information and data included in this description of the Westvaco plant, the writer is indebted to L. D. Vorce, consulting chemical engineer of Montclair, N. J., and to Benton Hopkins of the H. K. Ferguson Co., Cleveland, Ohio. Acknowledgment is also made of the courtesy extended by W. B. Thom, president and general manager and A. M. Pitcher, vice-president and plant manager of Westvaco Chlorine Products, Inc.



Synthetic Ammonia Costs in America

By R. S. Tour

Professor of Chemical Engineering,
University of Cincinnati, Cincinnati, Ohio

THE TOTAL upkeep cost of any plant includes all charges for repairs and for renewals, both current and deferred. The current repairs and renewals constitute maintenance; the deferred renewals and replacements constitute accrued depreciation. The above distinction serves to define these much-misused terms. However, even such definitions do not always clearly indicate the apportionment of costs under the different subdivisions of upkeep. Thus, the cost of deferred renewals or replacements, which should have accumulated under depreciation while being deferred, may be classified as current maintenance at the time the actual expenditure is made. In many instances, the distinction between maintenance and depreciation is not obvious and depends on the judgment of the accountant or engineer. Also, in the plant, repairs may be made frequently and a replacement of the unit postponed, or the converse may be accomplished. Thus, the cost sheet of a plant may show high current repair costs with a correspondingly low depreciation charge or vice-versa.

In this paper, maintenance will cover those current repairs or renewals which can be regularly accomplished by a permanent labor force employed for that purpose, with repair materials or renewal parts which in themselves do not constitute an operating unit of equipment as originally purchased. Maintenance under such a definition is somewhat more comprehensive than ordinary repairs and leaves for depreciation only such charges as are necessary to replace complete units of equipment at the end of their useful life.

Maintenance, current repairs or renewal of parts, as above defined, requires labor and supplies. The maintenance labor has been developed in this paper under the head of plant labor costs and includes all labor permanently employed for the purpose. The maintenance supplies are of two sorts; repair materials and renewal parts. The repair materials will be taken at one-half of the maintenance labor. The cost of renewal parts is most logically considered as dependent on the durability of equipment, i.e., on its depreciation rate. The cost of parts will be taken equal to one-quarter the depreciation charge. This allows of a total of one-quarter the cost of equipment to be expended for renewal parts during its useful life, after which it is replaced and this replacement charged to depreciation, later discussed.

It is obvious that the maintenance costs of a new plant do not reach their normal level for some years after the plant has been put into operation. It is further obvious that it is that normal level which is the correct maintenance charge for finding the true cost of the product, and it is on that basis that the maintenance labor and costs have been allowed for in this paper. The savings in this figure during the first years of

plant operation will be offset by the initial costs of developing the business, charges which decrease after the first few years and are not taken into consideration here.

Table IV—Plant Maintenance Costs, Synthetic Ammonia Processes
Production—40,000 tons N₂ or 48,570 tons NH₃ per year

	Annual Amount	Per Cent Physical Plant	Per Ton NH ₃ Production
Water-Gas Ammonia			
Maintenance labor.....	\$497,350	4.33	\$10.24
Repair materials.....	248,680	2.17	5.12
Renewal parts.....	127,950	1.11	2.63
Total.....	\$873,980	7.61	\$17.99
Electrolytic Ammonia			
Maintenance labor.....	\$426,910	3.35	\$8.79
Repair materials.....	213,450	1.67	4.39
Renewal parts.....	153,830	1.21	3.17
Total.....	\$794,190	6.23	\$16.35

THE DEPRECIATION charge, i.e., deferred upkeep or replacements, will depend entirely upon the estimated life to be allowed on the different units of equipment and buildings installed in the plant, keeping in mind the high charges for labor, materials, and renewal parts allowed under current maintenance. A detailed tabulation indicating the life estimated for different parts of ammonia plants is unnecessary here, but a general summary is given in Table V below. The uniformity of the life in all plants is striking, even though widely varying lives were ascribed to the individual units of equipment, such as 40 years for gas holders and for buildings, 15 years for liquid air columns and hydrogen compressors, 5 years for ammonia converters and exchangers. Without entering into a discussion of the relative merits of straight line and sinking fund depreciation charges, the former is being used in this paper, especially since the useful life of the plant was calculated as a straight line average.

Table V—Estimated Useful Life of Ammonia Plants
Production—40,000 tons N₂ or 48,570 tons NH₃ per year

	Physical Plant Cost	Average Life Years
Equipment, buildings, construction included		
Water-Gas Synthetic Ammonia Plant		
I. Gas manufacture.....	\$3,100,000	28.8
II. Compression, purification.....	3,215,000	21.9
III. Ammonia process.....	2,875,000	16.6
IV. Plant facilities.....	2,300,000	22.0
Physical plant total.....	\$11,490,000	22.45
Annual depreciation (4.45 per cent).....	\$511,800	
Electrolytic H₂ Synthetic Ammonia Plant		
I. Gas manufacture.....	\$7,345,000	21.4
II. Compression, purification.....	1,160,000	24.6
III. Ammonia process.....	2,450,000	15.9
IV. Plant facilities.....	1,800,000	22.0
Physical plant total.....	\$12,755,000	20.73
Annual depreciation (4.82 per cent).....	\$615,300	

The depreciation charges in Table V cover what is known as natural depreciation, caused by the ordinary wear and tear of operation or by the action of the elements. There is another form of depreciation which may be called functional depreciation or obsolescence brought about by improvements in the art or by increased demand in the plant. Obsolescence due to either of these

Dr. Tour's abbreviation of his paper, presented in full at the meeting of the American Institute of Chemical Engineers, St. Louis, Dec. 5-8, 1927, is concluded in this issue. The first part appeared in *Chem. & Met.* for February, 1928. Prints of the complete paper may be obtained from the author.

causes may be aggravated by a decrease in market value of the product.

It is evident that functional depreciation or obsolescence is much more difficult of calculation than is natural depreciation; but however great the difficulty, some allowance should be made for this contingency. The obsolescence charges in this paper will be taken at three per cent for water-gas ammonia and at four per cent for electrolytic hydrogen ammonia. These figures are merely allowances for a reserve against such obsolescence costs as cannot be properly amortized from resulting profits, and are not estimates of the total of such costs. The relative percentages above have been chosen after consideration of the recent trend of developments in each process.

It must be understood that the percentages allowed above as charges for obsolescence do not assume protection of the complete processes as such against obsolescence, but consider only the respective plants in competition with similar plants operating on the same process. This paper does not presume to prophesy or even discuss the obsolescence or permanence of any of the two nitrogen fixation processes considered.

Table VI—Depreciation and Obsolescence, Synthetic Ammonia Processes

	Annual Amount	Per Cent Physical Plant	Per Ton-NH ₃ Production
Production—40,000 tons N ₂ or 48,570 tons NH ₃ per year			
Water-Gas Ammonia			
Depreciation.....	\$511,800	4.45	\$10.54
Obsolescence reserve.....	344,700	3.00	7.10
Total.....	\$856,500	7.45	\$17.64
Electrolytic Ammonia			
Depreciation.....	\$615,300	4.82	\$12.67
Obsolescence reserve.....	510,200	4.0	10.50
Total.....	\$1,125,500	8.82	\$23.17

IN ADDITION to the investment in the manufacturing plant as developed under plant costs, operation will require funds as working capital invested in non-depreciable properties which may be classified as stores of materials and supplies, stocks of products, and cash capital. Working capital to finance the long-time credits characteristic of the fertilizer industry, to which ammonia plants must turn for their market, will not be considered, since such financing is not a valid charge against the production cost of the ammonia. In fact, no costs or charges have been or will be considered here which pertain to the product after leaving the plant site, such costs being properly classed as distribution or sales expenses.

Stores include the raw materials, the operating supplies, the repair materials and renewal parts for plant maintenance, as well as the office, utility, and laboratory supplies, kept in reserve in the yards, storerooms, or warehouses of the plant. These reserve stores will be considered maintained at an average of 90 days operating requirements, equivalent to 12,000 tons of ammonia. The per ton costs for the above may be obtained from the production cost estimates at the close of the paper; here it will suffice to summarize stores for 12,000 tons of ammonia as follows:

	Water-Gas Ammonia	Electrolytic Ammonia
Raw materials	\$287,400	\$27,600
Operating supplies	16,900	15,100
General supplies	12,500	10,400
Maintenance supplies	93,000	90,700
Total stores	\$409,800	\$143,800

Stocks cover all stocks of manufactured products, such as the intermediate products stored or in process, the minimum stock of finished product maintained on hand, and the variable stock of product necessarily carried, due to the seasonal demand for fertilizers. Stocks will be calculated as tons of ammonia though obviously they will not be stored as such. The stocks of final product will be stored in the form of ammonia compounds or fertilizers which are manufactured, handled, and stocked by a fertilizer plant subsidiary to the ammonia plant. The capital carrying charges for these stocks are logically made against the ammonia plant, while the handling and storage costs are properly charged against the fertilizer plant.

THE intermediate products stored or in process are negligible for the synthetic ammonia processes, but will be considered equivalent to 100 tons of ammonia. There should be maintained on hand a minimum stock of finished product equivalent to not less than 15 days plant production, i.e., 2,000 tons of ammonia for each of the processes. In addition to this minimum stock, there will accumulate during certain seasons of the year a stock of product awaiting demand and sale. The amount of this variable or seasonal stock may be best estimated from the past experience of the fertilizer industry in its sales. Based on such experience and presuming continuous production in the plant, the seasonal stock will accumulate as follows:

	Production Per Cent	Sales, Per Cent	Stocked, Per Cent	On Hand Per Cent
April through June.....	25	10	15	15
July through September.....	25	15	10	25
October through December.....	25	35	—10	15
January through March.....	25	40	—15	0

Presuming that short term loans are available against the variable stock on hand shown above, the average rather than the maximum may be taken for calculating the capital charges involved. This average seasonal stock will be 13.75 per cent of the annual production, or equal to 6,700 tons of ammonia.

To evaluate the above stocks of ammonia into capital or investment, it is merely necessary to know the plant operating expense (production cost less fixed charges) in each of the processes. This figure is available from the production cost estimates developed later in this paper and is used in the following:

	Water-Gas Ammonia \$83.87/Ton	Electrolytic Ammonia \$84.62/Ton
Stock in process (100 tons)....	\$8,400	\$8,500
Minimum stock (2,000 tons)....	167,700	169,200
Seasonal stock (6,700 tons)....	561,900	567,000
Total stocks	\$738,000	\$744,700

Cash capital to cover emergency expenditures, to maintain a cash balance for plant operation, and to finance miscellaneous funds can be limited to 30 days' operating expenses or equivalent to 4,000 tons ammonia. The cash capital allowed amounts to:

Water-gas ammonia	\$335,500
Electrolytic hydrogen ammonia	338,500

The working capital necessary for operating the plants is summarized in Table VII, together with the capital invested in plant construction, to indicate the comparative amounts of total capital required for the two processes.

FIXED CHARGES as here used will be considered to include accrued depreciation, obsolescence reserve, interest on investment, and taxes and insurance. The first two have already been discussed and estimated. There remain the items of interest on investment and of taxes and insurance to be calculated. These must be figured on the total of capital invested, as shown in Table VII. The interest will be taken at the accepted value of six per cent, although it is doubtful whether capital would be interested in the nitrogen fixation industry if it offered but a six per cent return. Taxes and insurance will be allowed at two per cent of the total investment or four per cent on a 50 per cent valuation.

Table VII—Capital Investment and Fixed Charges		
Production—40,000 tons N ₂ or 48,570 tons NH ₃ per year		
	Water-Gas Ammonia	Electrolytic Ammonia
<i>Capital Investment</i>		
<i>Manufacturing plant</i>		
Physical plant.....	\$11,490,000	\$12,755,000
Construction overhead.....	2,300,000	2,550,000
Total, plant.....	\$13,790,000	\$15,305,000
<i>Working capital</i>		
Stores.....	\$410,000	\$144,000
Stocks.....	738,000	745,000
Cash capital.....	335,000	338,000
Total, working capital.....	\$1,483,000	\$1,227,000
TOTAL INVESTMENT.....	\$15,273,000	\$16,532,000
PER ANNUAL TON NH ₃	\$318	\$340
<i>Fixed Charges</i>		
<i>On physical plant</i>		
Depreciation.....	\$511,800	\$615,300
Obsolescence reserve.....	344,700	510,200
Total.....	\$856,500	\$1,125,500
<i>On invested capital</i>		
Interest (6 per cent).....	\$916,400	\$991,900
Taxes and insurance (2 per cent).....	305,500	330,600
Total.....	\$1,221,900	\$1,322,500
TOTAL FIXED CHARGES.....	\$2,078,400	\$2,448,000
PER TON NH ₃ PRODUCTION.....	\$42.79	\$50.40

PRODUCTION COST is the sum of all costs of (1) process operation, (2) general plant expense, (3) current maintenance, (4) miscellaneous and contingencies, and (5) fixed charges. The first four of these constitute the operating cost or operating expense, each of the four consisting of labor, materials, supplies, and power.

The data necessary for summarizing the costs in process operation and in general plant expense have been developed in preceding parts of this paper. The labor costs in each are to be found under operating labor costs. The per-ton quantities of process materials and power for each of the plants are tabulated under operating quantities. It remains only to decide on the unit costs for materials and for power and to determine the allowance for supplies.

The unit costs of power and materials differ with the location of the plant site, but certainly a plant will locate to its best economic interests and therefore fairly low unit costs may be used for the purposes of this paper. The power cost is taken at 3.0 mills per kilowatt-hour or slightly under \$20 per horsepower-year (\$19.60). Coke is charged at \$7.50 per ton; coal at \$4.00 per ton; all f.o.b. cars at the plant. The costs of the special materials (i.e., catalysts, purifiers, etc.) are estimated at \$3.75 per ton ammonia for the water-gas process and at \$1.10 for the electrolytic modification. Operating supplies are allowed at 10 per cent of the labor costs.

After definitely specifying the major items of cost under the heads of process operation, general plant

expense, and current maintenance, a miscellaneous and contingency charge of 10 per cent of the specified operating costs is added to allow for such indeterminate expenses as salaries of corporation officers, legal expense, consulting engineers' fees, travel allowances, overtime labor, non-listed labor, vacations, temporary inefficiency of operation, poor materials, failures of equipment, accidents, or other legitimate though unforeseen charges against operation.

The production costs per ton of ammonia are tabulated in Table VIII below.

Table VIII—Ammonia Production Costs		
Production—40,000 tons N ₂ or 48,570 tons NH ₃ per year		
Costs per ton NH ₃ produced		
	Water-Gas Ammonia	Electrolytic Ammonia
<i>Process Operation</i>		
Process labor.....	\$14.11	\$12.64
Process materials.....	23.95	2.30
Operating supplies.....	1.41	1.26
Power.....	6.75	34.35
	\$46.22	\$50.55
<i>General Plant Expense</i>		
Office and utilities labor.....	\$10.40	\$8.71
General supplies.....	1.04	.87
Miscellaneous power.....	.60	.45
	\$12.04	\$10.03
<i>Current Maintenance</i>		
Maintenance labor.....	\$10.24	\$8.79
Maintenance supplies.....	7.75	7.56
	\$17.99	\$16.35
<i>Miscellaneous and Contingency</i>		
Non-specified, indeterminate.....	\$7.62	\$7.69
<i>Fixed Charges</i>		
Depreciation.....	\$10.54	\$12.67
Obsolescence reserve.....	7.10	10.50
Interest on investment.....	18.86	24.22
Taxes and insurance.....	6.29	6.81
	\$42.79	\$50.40
PRODUCTION COST PER TON NH ₃	\$126.66	\$135.02

Abstracting Table VIII, the following comparative costs of ammonia for the two processes are enlightening. *Process* or *prime* cost is the direct cost of only the process labor, materials, and power. The *operating cost* is the cost of ammonia production without fixed charges. The *production cost* is the entire cost or expense chargeable to the product. Attention is called to the danger of confusing or misinterpreting these three different types of costs.

	Water-Gas Ammonia		Electrolytic Ammonia	
	Dollars per Ton	Cents per Lb.	Dollars per Ton	Cents per Lb.
Process (or prime) cost.....	46.22	2.31	50.55	2.53
Operating cost.....	83.87	4.19	84.62	4.23
Production cost.....	126.66	6.33	135.02	6.75

THESE FIGURES have been developed and based on certain assumed conditions, a departure from which would affect the figures accordingly. Little departure is possible in the process cost. However, some of the other elements involved in the production cost may differ from this paper in special cases. Departures from the assumed general conditions considered cannot be evaluated except in the individual cases, and then would serve but little purpose in a cost comparison.

Although many variations from the cost figures estimated in this paper are possible in individual cases, that fact does not vitiate the importance of a comparison, under the same general conditions, of the costs for synthetic ammonia plants and production in America. In view of this, it is hoped that this paper will be of some service to the chemical engineering profession in spite of the very natural prejudice existing against all published cost data.

Providing Chemical Treatment For Petroleum Emulsions

By Charles W. Cuno

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PETROLEUM emulsions occur in the oil fields as products obtained directly from wells and also as gradual accumulations in the bottom of storage tanks and pits. They are generally referred to as "bottom settings," "cut oil," or "roily oil." These mixtures consist essentially of particles of water dispersed throughout the oil and held in suspension due to a substance which acts as an emulsifying agent. This substance is not in true solution, as will be seen later, but is colloidal and acts as a protective colloid.

Analysis of various oils that produce water-oil emulsions discloses the fact that they carry varying amounts of asphaltic material while the paraffin-base oils produce no such emulsions. The simple agitation of oil and water in contact with each other does not produce a stable emulsion. There must be an emulsifying agent present. To produce a "water-in-oil" emulsion there must be an oil "soluble" (strictly speaking, oil wettable or dispersible) agent present. In this case the asphaltic materials act as such as may be readily demonstrated by the following laboratory experiment.

When equal volumes of water and kerosene are shaken together vigorously, an emulsion is apparent only as long as agitation continues. As soon as shaking stops the milky appearance disappears and the kerosene and water form two layers. If even a very small amount of soap solution is added, however, the emulsion becomes more or less permanent, and is of the oil-in-water type. On addition of a few drops of vinegar which reacts with the soap, the emulsion breaks. If on the other hand, the same water and kerosene is shaken up with a small amount of asphaltum dispersed in oil, an emulsion will be formed which is of the water-in-oil type and upon which the vinegar has very little or no effect.

In the oil fields, four general methods are used for destroying, or breaking up these emulsions, —heating, electrostatic precipitation, centrifuging and chemical treatment. The magnitude of the problem is indicated by the U. S. Bureau of Mines estimate that more than one-fifth of the Mid-continental oils and at least 25 per cent of the California oils must be thus treated before they are acceptable to pipeline carriers. Of the above, it is believed, the quantity treated chemically is in excess of all other methods.

THE pioneer in the field of chemical treatment of "cut" or "b.s." oils was the late Wm. S. Barnickel, whose patents as early as 1914 relate to the subject. The company he founded manufactures a number of compounds, most of them liquid, oil

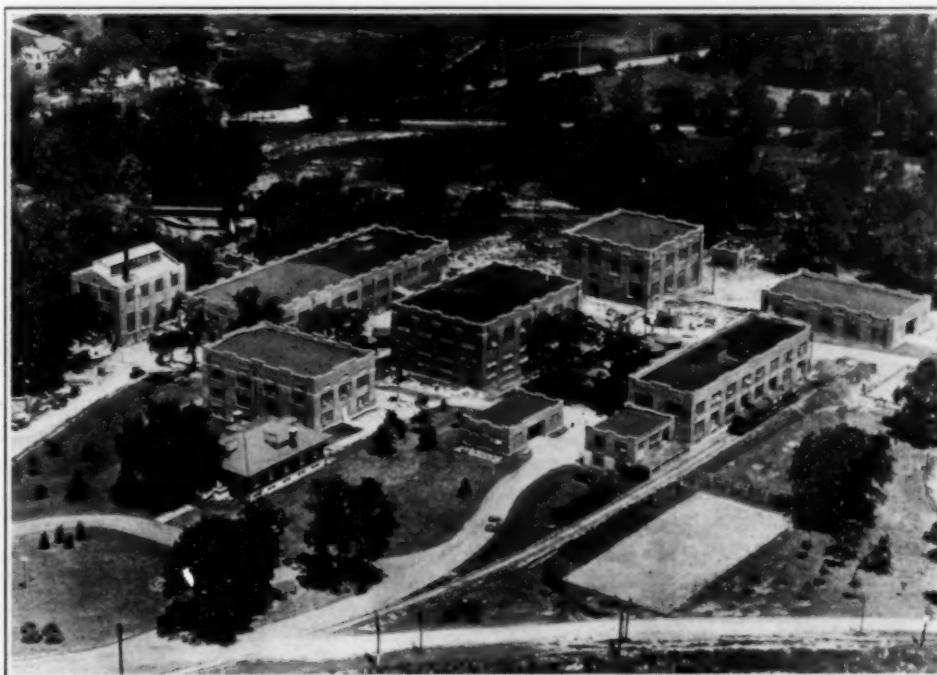
soluble, or at least oil dispersible the nature of which, while differing for each oil, may, in general, be said to be organic compounds, water softening agents, etc., whose specific reaction is either to dissolve the emulsifying film, flocculate or coagulate it, or act as a counter emulsifying agent to neutralize its action. These products are sold under the trade name of Tret-O-Lite. They are used in either continuous or batch processes. In the former case a special device adds a measured quantity of material directly to the pipe line from the pumping well and the water is separated from the oil in a settling tank. Batch treatment is carried on in a separate treating tank.

The plant which is located at Webster Groves, a suburb of St. Louis, covers 25 acres of ground and has ten buildings. It produces approximately 50 different products which are used in most domestic and many foreign oil fields.

Not the least interesting of these buildings is a complete and modern testing and research laboratory where unusual methods have been developed for testing various petroleum oils for the purpose of discovering the most economical reagents for breaking emulsions. In addition, the company maintains a corps of field experts capable of advising producers concerning plant installation and operation.

The quantity of reagent required for treatment varies with the emulsion, but averages about one part to ten thousand parts of petroleum emulsion. In some cases as low as one part to 40,000 has proved efficient. The costs of treating are low, approximately one cent per barrel. Other advantages are that substantially all varieties of cut oils are susceptible to chemical treatment, that installation and power costs are low, and that no sludge is produced since the products are only pipe line oil and waste water.

EDITOR'S NOTE. A number of new chemical industries have developed in the St. Louis district since 1920, the date of the last national meeting of the American Chemical Society in that city. One of these, which will doubtless be visited by many during the April 16-20, 1928, meeting, is the plant of the Wm. S. Barnickel Company which Dr. Cuno has described in this article.



Research Laboratories and Plant of the William S. Barnickel Company at Webster Grove, a suburb of St. Louis, Mo.

Radio Control of Paper Drying Features T.A.P.P.I. Sessions

Editorial Staff Report

CROWDED corridors in the Waldorf between February 20 and 23 testified once more to the occupation of New York by the genial army of paper men, assembled for their annual conventions. Where the blue bunting banner proclaimed it's "Welcome Tappi," a large and representative attendance of members of the Technical Association regaled themselves by "talking shop" to their hearts' content in the characteristic camaraderie that has so greatly stimulated technical development in the pulp and paper industry during the past decade.

The focal point of interest in Tappi's thirteenth annual convention program was W. D. Sommerville's paper on "Radio Control of Moisture in Paper Drying." Using the principle that the capacitance of a condenser is measurably affected by minute changes in length and weight of a dielectric placed between its plates, the Eastern Manufacturing Company has developed an apparatus which not only registers the moisture content of the moving web of paper but also actuates the steam valves regulating the driers, thus keeping the moisture content much more constant than is possible by the most expert manual control. An extension of the same principle will provide means for making a continuous record of the weight of moving bodies without physical contact with the substance to be weighed. Changes in length too minute for detection by calipers may be measured thus, electrically. In fact, an entirely new system of measurement is made possible, the applications of which should be of interest in the many process industries where close continuous control is desirable. The device is in actual use for controlling the moisture on paper machines and considerable experimental work has been done on the project of controlling the paper weight. It has been successfully applied in the rubber industry where it is used for weighing a moving web and has made possible large savings.

Lively interest was manifest in the discussion precipitated by a paper on "Technical Problems in Waste Utilization and Stream Improvement," presented by C. M. Baker, engineer of the American Pulp and Paper Association. The various types of stream pollution, domestic and industrial were described, with a rational discussion of the effects on aquatic life and the accompanying or resulting effects on the public welfare and comfort. Specific data on conditions in the Fox and Wisconsin Rivers, made by the Wisconsin State Board of Health and the pulp and paper industry of that state were presented. It was shown that sulphite waste liquor, the most objectionable waste from pulp mills, contributes markedly to the pollution load of the stream. If 85 per cent of the sulphite waste liquor were prevented from entering these streams, the pollution load would be improved over 50 per cent, or, in other words, the streams would safely carry off a sewage load from more than half again as large a population.

There followed an animated discussion on the feasibility of evaporating and burning of sulphite waste liquor. H. J. Skinner, of Skinner, Sherman and Esselen put forth the novel but not entirely popular point of view that the disposal of waste sulphite liquor

should not be decided upon a basis of possible profit or loss, but that the paper makers should consider "cleaning up the mess they make as a legitimate item of their costs." H. A. Rothchild, of the Kimberly-Clark Company, told of the plans of a committee formed by Wisconsin mills to conduct a nation-wide survey of the sulphite waste disposal problem, the expense to be divided pro rata among the mills. The status of the Badger Company's system of disposal and the Howard process were discussed, the chairman, President Tucker, concluding the discussion with characteristic finality by eliciting from Mr. Baker a negative reply to the direct question, "Do you know of any mill which is burning its liquor on a commercial scale today?"

OTHER papers of more than passing interest were those by G. K. Spence, of the New York and Pennsylvania Company, on "Control of Beater Furnish to Eliminate Foaming," W. F. Hoffman, of the Northwest Paper Company on "Hydrogen Ion Measurements in the Pulp and Paper Mill," W. E. Brawn, of the Pejepscot Paper on "Artificial Grindstones, Anti-Friction Bearings and Vacuum Thickener Developments." Prof. G. W. Scarth, of McGill University, presented a most interesting paper on the "Structure of Wood and its Penetrability."

The reports of committees, several of which were exceptionally active during the past year, bore witness to the broad influence the technical men in the industry are exerting through their Association. The splendid work of the committee on abstracts and bibliography in classifying and tabulating current literature of interest was specifically recognized in a resolution, presented by G. K. Spence, in which Tappi expressed appreciation to the National Research Council for permitting Dr. C. J. West, chairman of the committee, to devote so much time to this undertaking. The committee on training for the industry reported through Allen Abrams, its chairman, on the plan for appointing "area directors" to co-operate with schools and colleges in bringing the right type of men into the industry.

FROM the social standpoint, the highlight of the convention was the annual banquet at the Commodore Hotel, on Feb. 22. E. R. Weidlein, director of the Mellon Institute and president of the American Institute of Chemical Engineers, delivered the principal address, driving home the far-reaching benefits to industry of applied research by touching on the many industries which have suddenly grown up, and others which have completely changed their products as a result of the rapid shifting market demands created by research developments. His address, being extemporaneous and calling forth dozens of fascinating examples from the speaker's broad experience, was as absorbing as it was stimulating. Dr. Hollis Godfrey, president of the Engineering Economics Foundation, spoke on adult education and the economic value of continued training after the school and college period, tabulating data to show the relation of education to national wealth.

The following officers were elected for the ensuing term: President, E. C. Tucker; Vice-President, P. H. Glatfelter; Secretary-Treasurer, R. G. Macdonald; Executive Committee: Chairman, E. C. Tucker; P. H. Glatfelter; Allen Abrams; H. O. Keay; R. H. Laftman; B. T. McBain; M. A. Krimmel; E. R. Low; W. G. MacNaughton and R. G. Macdonald.

Petroleum Technologists Discuss Heat Economies

Editorial Staff Report

ECONOMICAL application of heat in petroleum refining was the keynote of the refinery engineering sessions of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers held in New York City February 22 and 23, 1928. Walter Miller, vice-president of the Marland Refining Company, who retired as vice-chairman of the refinery engineering division, declared that during the past year more progress had been made in methods and equipment for heat utilization than in any similar period in the development of petroleum refining technology. "Drastically severe commercial and economic conditions controlling the refining industry in 1927 gave a great impetus to better efficiency and more economical operation in all departments," according to Mr. Miller, but, he added, "most progress was made in heat utilization, using the term utilization in the dual sense of better primary generation and application of heat and its saving by recovery methods."

In his review of the year's advancement in refinery technology, the vice-chairman showed how the rational use of fundamental data on heat transfer had resulted in raising transfer rates from 3,000 to 6,000 B.t.u. per sq. ft. per hr., to 25,000 to 35,000 B.t.u. in many commercial installations. Study and application of the principles of radiant heat in furnace design have contributed largely to this advance. Better heat exchange in distillation operations has resulted from the development of thin-walled tubular exchangers designed to provide for high velocity of both vapors and liquids. Oil preheating temperatures as high as 250 to 500 deg. F. are being obtained by the proper co-ordination of vapor heat and residual heat exchanges. Application of the same principles and similar equipment has improved methods of removing heat in condensation.

On the processing side of refining Mr. Miller cited progress in the further development of fractionating equipment, in the single and multiple flash distillation of petroleum products, and in both the chemical treatment and the vapor-phase filtration of distillates. In the high-pressure cracking field, the trend has been toward larger units and modification of oil flow to improve operation. Vapor-phase cracking received more attention during 1927 than ever before—stimulated principally by the growing recognition of the high anti-knock value of the product.

MUCH interest was evidenced at the refinery engineering symposium in a paper on the sources of automotive fuels by F. A. Howard and R. T. Haslam of the Standard Oil Development Company. The primary sources of gasoline were evaluated in the following order: (1) crude petroleum, (2) shale and (3) coal via hydrogenation, while the supplementary sources were classified as (1) natural gas, (2) coal via distillation or gasification and (3) carbohydrates. Referring to coal, Dr. Haslam cited the progress being made in a great hydrogenation plant which has been completed at Merseburg, Germany, by the I.G. Farbenindustrie A.G., and which is now well started on commercial operations. The coal used is low-grade lignite or brown coal and the

motor fuel produced is of good marketable quality not readily distinguishable from gasoline derived from crude petroleum. "Those of us," declared Dr. Haslam, "who have had the privilege of visiting this wonderful development at Leunawerke leave with the feeling that the applied science of chemistry and engineering can face the future with some assurance in the conviction that the world will never want for automotive fuel at a reasonable price as long as coal is available."

In answer to a query by R. E. Wilson of the Standard Oil Company (Indiana), the speaker brought out the fact that the new Bergius fuel has anti-knock properties approximately equivalent to those of cracked gasoline. While exact costs of the new fuel are not generally known, the fact that it is being put on the market in Germany in competition with gasoline from crude petroleum, would seem to indicate that the present costs are not excessive. An important point in favor of hydrogenation, which was brought out in the discussion, is that coal resources may be definitely gaged and mineral rights reserved for future development, while as long as ground oil is available we are likely to have rapid competitive exploitation. In general, Howard and Haslam conclude that through hydrogenation, the coal reserves of the world are now also its oil reserves.

H. W. CAMP, general superintendent of refineries, Empire Oil & Refining Company, and newly elected chairman of the refinery engineering division, gave a paper on the opportunities for co-operative research in the petroleum industry. He referred particularly to the possibilities of developing a synthetic chemical industry that would share in the present annual consumption of some \$900,000,000 worth of chemicals, a large portion of which is capable of synthesis from petroleum. Research has already pointed the way toward developing wider markets for existing petroleum products as well as new products for existing or prospective markets. Mr. Camp mentioned recent developments in the use of butane as an efficient and inexpensive refrigerant, propane as a substitute for acetylene in welding, butane as a substitute for gas oil in carburetion of coal gas, and ethylene in the artificial ripening of fruit.

Citing the progress of the research program of the Natural Gasoline Association and also that of the American Gas Association, Mr. Camp declared that "A centralized research program supported by the petroleum industry as a whole would economize on funds and personnel, minimize the duplication of work and co-ordinate discovery. The benefit accruing from such a program would be greater than any results attained by independent research on the part of the various divisions of the industry. The different branches of the petroleum industry are inter-dependent and the general prosperity of one is conditioned on the prosperity of the others. Due to this interdependence, the scope of the problem and the fact that the petroleum industry is dealing with essentially the same class of chemical materials, it is vital that the entire industry should unite in a co-operative research program."

Slight differences in opinion developed in the discussion. Dr. B. T. Brooks held a less optimistic view as to size of the possible market for petroleum chemicals. Dr. T. G. Delbridge, on the other hand, was inclined to share Mr. Camp's view. All agreed, however, that more co-operative fundamental research is the desirable objective.

Making for Profitable Prosperity

Conference of Chemical Executives held in Washington, February 16, 1928, told that industry must be put on firm dual foundation of efficient distribution as well as of economical production

By Julius Klein

Director, U. S. Bureau of Foreign and Domestic Commerce, Washington, D. C.



ALL too frequently prosperity is assumed to be synonymous with business activity. It is time that we realized its identity with the full time operation not simply of the plant but of the cash register as well. The rumbling of the former is just so much meaningless noise without the ring of the latter.

There have been frequent references of late to the "various essentials of prosperity." Of course, at bottom there really is but one, namely that it should pay. But in the present stage of American business development, there are two factors or functions which ought to contribute substantially more than they do toward the attainment of this objective: (1) The most rigorous scrutiny of the costs and wastes of distribution; and, (2) the fullest exploitation of foreign markets.

The latter topic has been frequently in the press and there is ample evidence of the rapidly increasing appreciation of its significance; for example, the number of inquiries on foreign markets which are being directed to the Department of Commerce by American business men has increased from seven hundred a day early in 1921 to more than 10,000 a day at present. But the matter of better domestic distribution, in spite of the increasing publicity that has been given to the problem is still evidently in need of much further analysis and exploitation.

We have gone far in the progress of waste elimination and production, in some directions perhaps as far as is feasible for the time being. Certainly, the efficiency of our productive methods, which has aroused world wide amazement, has reached almost incredible success. The automobile industry, to cite an outstanding example, turned out nearly 4,300,000 units during 1926 with 375,000 employees, or an average of 11.5 per employee, as compared with 10.0 in 1922.

It has been frequently pointed out of late that the value of our manufactured products increased from 1923 to 1925 (the last available census figures) by not less than \$2,500,000,000 and that meanwhile there was a decrease of some 400,000 employees. This brings up the element

of the reactions of one aspect of the efficiency program, which has occasioned some unwarranted alarm, namely the alleged prospect of unemployment as the result of mass production and the greater application of labor saving machinery. With reference to the above figure, however, it is well to note in the first place that the earlier census included certain factories which were omitted in the second and the reduction of employees is, therefore, not strictly represented by the 400,000 figure. Nevertheless, there can be no doubt that there has been a very substantial decline in factory employment during the deflation of the wartime industries and the general introduction of simplification, standardization, and other phases of waste elimination. According to some estimates, the decline in manufacturing payrolls since 1919 has approached 900,000.

But did this represent a corresponding increase in unemployment? It is well known that improvement in production methods of any industry ultimately redounds to the benefit of the general well-being, including employment, of the whole community; but in the course of the readjustment some temporary hardships may be experienced.

WHAT has happened to the many thousands who have admittedly been displaced in our factories by machinery? The answer is simple; they have gone into non-manufacturing pursuits. During this post-war period the number of workers engaged in automobile servicing and distribution has increased over 750,000. The new-born radio trade, exclusive of its manufacturing aspects, has taken on about 125,000 more helpers in that time. Motion picture theatres and services, exclusive of production, account for another 125,000 increase. The most impressive single figure is in personnel for hotels and restaurants. There are no precise data on this item, but various estimates of the increase in employment rolls of this industry since 1919, run upward from 500,000 to nearly one million—an astonishing figure, but even with liberal discount it remains one of the two outstanding elements in the growth of employment since the War.

These are but fragmentary data but they are quite sufficient to indicate that the net increase of employment in distribution and servicing functions, which, after all, are the direct and immediate outcome of greater production, has more than taken up the slack created by any curtailments in manufacturing payrolls.

This raises the broad problem of the increasing burden of our distribution system,—its vastly increased responsi-

bility as an adjuster of the slack in our economic machinery. It must do its work well if the machine is to produce the ultimate essential, profit. But is it performing satisfactorily?

Recent tabulations by a responsible research agency of the income tax returns of seventeen groups of corporations in industry and trade for 1925 have revealed some interesting facts. It is true that 1925 was only a fair year and the more recent period has been decidedly more profitable; nevertheless, the former year can be taken as a typical point in the post-war development. The data show a profit of 5.8 per cent for manufacturing, 5.7 per cent for amusements, 12.5 for banking, 5.7 for mining, 4.6 for construction, etc. But far below, at the very bottom of the list, save for agriculture, is retailing and wholesaling with a profit of only 2.2 per cent.

The supposedly shrewd "Yankee trader," the exuberant go-getter salesman, still seems to have much to learn to make his trading and high-pressure selling pay profits. In fact, one is forced to wonder whether the pressure is worth the price; evidently there is much steam up—but, is it getting us anywhere?

Another survey as to the causes of the difficulties encountered by some concerns in 1925 revealed as the chief obstacle which impaired the prosperity of 91 per cent of the firms involved, the "greatly intensified competition" which they were encountering. There has, of course, been a substantial improvement in the general situation during 1926-27. But it is clearly evident that these figures must be reduced if the nation's business is to be put on the firm dual foundation of efficient distribution as well as of economical production, if the gains made in the latter are to be conserved through corresponding frugality and sound policy in the former.

But in answer to the query directed to these distressed firms, "What are you doing about it?" 73 per cent of these firms reported that they were endeavoring to reduce production costs, and only 29 per cent indicated any efforts to cut sales expenses. In spite of repeated pronouncements in the trade press, and by competent observers during recent years as to the imperative necessity of more effective profit yielding distribution, these facts still appear to require repetition and emphasis. It is time that we disposed of at least a few of the more flagrant wastes in domestic selling,—wastes, which, according to conservative estimates, are squandering from 20 to 50 per cent more each year than our entire five-billion-dollar export trade. And yet how many fervid after-

dinner orations on foreign trade have all of us had to suffer through as compared with those on this much more formidable and ominous red-ink item on the national business ledger?

THE perils of careless sales campaigns are too obvious to require detailed discussion. But a few concrete instances from recent observation might well be cited. First, there is the wastefulness of "blind" marketing, of attempting to sell in territories whose sales possibilities for the given commodity have not been carefully investigated. A paint concern, which is big enough to know better, launches a widespread sales campaign in a certain state simply because it was listed as "good, prosperous territory," ignoring the fact that 85 per cent of its dwellings are made of brick and offer at best only a moderate potential increase in demand.

Secondly, there is the perennial longing to exploit remote territories, whose distance lends them enchantment, but whose inaccessibility makes for costly traveling salesman campaigns. Such broad scale operations are undertaken all too frequently for the sole purpose of gratifying the vanity of executives of the firm whose product has been described to them by some energetic advertising solicitor as "an undoubted national necessity and, therefore, deserving of a national market."

Thirdly, there is the increasing necessity for close contact between the manufacturer and his market. This does not necessarily involve the elimination of the job-

ber, commission house, wholesaler, or other distributive intermediaries, many of whom perform valuable services in some lines, although they are gradually disappearing in others. I refer particularly to the urgent need of watchful observance by the producer of the conditions and desires of his ultimate consumer in order that any change in demand may be anticipated and production allowance or alteration made for them. The distress of certain plants in the older industrial centers of the country is all too frequently due to precisely such lack of contact with their ultimate consumers. Any such "blindness" on the part of the manufacturer is certain to spell ultimate disaster.

The maintenance of such contacts by no means requires an elaborate costly research agency. The facilities of the Department of Commerce and numerous other organizations are ample to keep any intelligent, far-sighted manufacturer advised as to market changes and the factors which effect the demand for his product.

Chemical Industry Invited to Make Known Its Needs

BY INTELLIGENT and persevering constructive effort over a series of difficult years the American chemical industry has established itself as a self-contained and essential part in the industrial and economic fabric of this country. Its problems have been faced with keen thought and determination. Many have been solved. Others, such as technical research, decrease in distribution costs, relationship to other industries, and foreign competition and markets have been solved only in part. The Department of Commerce was created for service and is anxious to be of assistance to the industry on these or other problems. We can serve only by direction of the leaders in the industry. Therefore the industry is asked to express its needs to the Advisory Committee of the Chemical Division or to us direct in order that we may move forward to a still higher plane of constructive cooperative accomplishment.

HERBERT HOOVER

Secretary of Commerce.

German Chemical Industry Intent on World Consolidations

By William T. Daugherty

United States Trade Commissioner at Berlin

CHEMICAL production in Germany has shifted since the war. A dyestuffs production of some 80,000 tons now, against probably 135,000 tons before the war, is being compensated for by production of a new synthetic nitrogen industry and other branches. Germany is at present producing some 700,000 tons of fixed nitrogen annually—of which 310,000 tons is fixed in ammonium sulphate, 320,000 tons in synthetic nitrates and the rest, 70,000 tons nitrogen, in calcium cyanamide. This compares with barely 15,000 tons of synthetic fixed nitrogen production in 1913 and 110,000 tons in coke-plant byproduct sulphate. The dye trust can produce at its Leunawerke about 20,000 tons of synthetic methanol annually, but is not producing more than from 10,000 to 15,000 tons, varying with demand, because of its agreement with the wood distillers. Plans have been announced to produce 100,000 tons of synthetic gasoline this year in the new lignite hydrogenation operation, also at the Leunawerke.

CARTELS as associations of producers to regulate production, allocate markets, and to fix prices, but pre-eminently to pool sales of members, are a peculiarly German institution in origin and history. The German chemical industry is essentially sensitive to cartellization, by virtue of its susceptibility to overproduction. Virtually all German producers of chemicals, whether they have bromine, benzol, superphosphate, creosote oil, paints, or lacquers, or one might continue with an endless list, are associated in a horizontal cartel, selling for the group and allocating profits accordingly. When a cartel combines producers of varying production costs, it protects the weak against the strong. Consider the chemical bromine, for instance. The German bromine syndicate, to my own knowledge, has one member potentially able to produce this product from carnallite waste liquors at no more than 50 pfennigs per kilogram. It costs other cartel members more, and the net result is that the market price is three marks, or around 75 cents per kilogram. Again, German cyanamide producers doubtless operate

at more cost than Haber-Bosch manufacturers, but cyanamide, pooled in the Nitrogen Syndicate, is priced at 7 pfennigs per kilogram less than Haber-Bosch production.

A somewhat unique German cartel is the much-advertised potash syndicate. This cartel, like the Ruhr coal syndicate, is created by law. It combines all producers and the law specifies that production be allocated. To

meet competition, however, the potash syndicate has gone through a process of comparatively intensive concentration in the past two or three years. It has closed down the more unproductive of 228 potential potash shafts in Germany and is operating about 60. An important circumstance, as far as the American consumer is concerned, is that closed-down shafts are compensated under the

Here is a first hand account from an experienced observer of recent economic and technical trends in German chemical industry. Contrary to the general view that the European chemical trust was designed to curb the American industry, is the reported attitude of German dye trust officials in welcoming agreements with responsible chemical firms in the United States. Three German-American pacts were made last year and others are in prospect. Does this mean future dominance of world chemical industry?

law, thus burdening the price of potash to the consumer accordingly. This item may cost the cartel between 50 and 70 million marks annually while the industry's annual obligations under the reparations plan, and interest and amortization on its \$75,000,000 loan burden the industry with a total of some half million marks indebtedness. It is thus not difficult to understand the allegation that German potash production costs are higher than French (Alsatian), although German costs are potentially lower, if competition were open, and the best 17 or more German potash shafts could be thrown into competition with the 17 Alsatian shafts with their high percentage sylvinites. One can conservatively estimate that 12 of Germany's best potash mines, under conditions of free competition, could meet world demand for cheaper potash and byproducts.

Horizontal cartels have led the way through to complete mergers, a fact exemplified most strikingly in the case of the world-famous German dye trust, the "I.G.," with an interesting subsidiary cartel, namely the Nitrogen Syndicate, a self-styled "ideal cartel," intent on price reductions to boost sales of a product that may soon attain a point of market saturation.

The scope of the dye trust¹ may be gaged from the

¹Extracts from an address presented before the Second Meeting of Executives of the Chemical Industry held under the auspices of the Department of Commerce in Washington, D. C., February 16, 1928.

²The reader will find more detailed information in "German Chemical Developments in 1927," by William T. Daugherty, Trade Information Bulletin No. 532, U. S. Bureau of Foreign and Domestic Commerce.

fact that according to estimates it produces now one-third of Germany's entire chemical production, employs one-fourth of all chemical labor (some 88,000 persons) and controls over 60 per cent of the capital of all German chemical corporations.

BEING the largest consolidation in the German chemical industry, the German dye trust is fitted to present a solid front in treating with similar consolidations abroad. Its most outstanding parallels in Europe are the Imperial Chemical Industries, Ltd., of England and Etablissements Kuhlmann of France, both in turn being mergers. It was announced recently that the German dye trust had concluded an agreement with Kuhlmann on dyes, calculated to regulate inter-trading in dyes produced by the two, but particularly to divide export markets. Under this arrangement, the Germans probably acquire 80 per cent of exports of dyes by the two parties, while the French get the other 20 per cent. It was agreed that exports would be proportionate to respective production. It may be estimated fairly closely that while the Germans are producing 75,000 to 80,000 tons of dyestuffs annually, the French produce 15,000 to 20,000 tons.

The Franco-German dye pact, concluded last month, recalls a parallel agreement between these two nations finally ratified in December, 1926, dividing potash export markets in the ratio of 70 per cent to Germany and 30 per cent to France.

These two agreements stand out in particular relief, first, because they represent a drift toward an economic entente cordiale between the two bitterest enemies of the late war, and secondly, because they set the stage for other agreements with other countries. There are many of the latter already, although nothing much has been said or printed about them. They refer to price-fixing and even production allocation agreements on specific chemicals. The Germans quite recently framed such an agreement with the Austrians and the Czechs, principally on alum and its salts, and on certain ammoniates. A dye sales arrangement is also in effect between the German dye trust and the Spanish. A nitrogen sales arrangement on Oriental markets exists between the Germans and British. For quite some time, special price and market division agreements have been in effect between German and British producers on benzol, borax, creosote oil and glauher salts, among other products.

IN VIEWING the effect of these agreements, it is well to consider that while they refer to price uniformity, and in cases to allocation of production—to combat inevitable over-production—they are aimed especially at savings on freight hauls, since the freight rate on heavy chemicals is particularly burdensome. Thus, if the Germans and Austrians agree to allocate markets on certain chemicals, it stands to reason that the Austrians would sell the Near East, while Germany would sell its surrounding territory. In a recent conversation Doctor Bueb, who wished to illustrate this point, put the question: "Why do you Americans sell ammonium sulphate to Japan, and then turn around and buy the same product from us over a tariff of five dollars a ton?"

Though deadlocked for the time being, it can be little doubted that eventually an agreement will be reached between German dye trust and Imperial Chemical Industries in England. It would appear that such an agreement, as in the case of its predecessors, especially the

Franco-German dye and potash agreements, would also be confined to specific products and not to the entirety of production of both trusts. A likely subject for bargaining, for instance, would be dyes. The British could conceivably welcome German technique in dyestuffs production in exchange for a share of British and Colonial markets. This arrangement was proposed in negotiations between 1922 and 1924 but was finally vetoed by the British Government. Apparently the fear still remains in Britain that the German dye trust inclines to demanding the lion's share in such an arrangement and that the British dyestuffs industry might thus come under Teutonic domination.

Nitrogen is another promising subject for bargaining between the German dye trust and not only Great Britain but other countries. An agreement on nitrogen would seem unavoidable in view of threatening over-production. It may be predicted that by 1930, the Germans will be fixing one million tons of primary nitrogen annually, when the Leunawerke of the dye trust are further expanded and some other new units, particularly the Mont-Cenis process (at Sodingen) utilizing coke-oven gas hydrogen goes into full operation of 100,000 tons nitrogen annually. Only last year, the German dye trust made a pact with the Norwegian Norsk Hydro arc process plant and acquired a substantial portfolio of its shares. This act made the Germans part owners, with the French, of the Norwegian plant.

On the other hand, the dye trust has shown itself indisposed so far to treat with Chile producers, although I am informed the latter have approached the German syndicate with offers for an agreement.

GERMAN dye trust officials have been considerably exercised of late by press reports that their chemical industry intended to consolidate for the particular purpose of opposing the best interests of the American chemical industry. While it is not the purpose of this discussion to reach any definite conclusions on this controversial issue—and granted that the effects of European consolidations have an unavoidable reaction on world competition—I can quote certain leading figures of the German dye trust who deny first that they are out to fight the American chemical industry, and secondly that the dye trust has bought heavily into shares of the American chemical industry. They emphasize, on the other hand, that it is their wish to frame agreements with elements in the American chemical industry as far as this is possible and cite as proof of this at least three German-American agreements arrived at in the past year. They indicate also that further special agreements with American chemical and related companies are in sight.

Before leaving Berlin last month, I was told substantially the same thing by Doctor Bueb, the dye trust's leading figure in that city, and he stated further that if accurate information were wanted concerning the dye trust's plans in connection with international tie-ups, either he or Doctor Bosch would welcome questions from any responsible American firm, association, or individual.

The dye trust's brief of argument is of course that rationalization, begun after the inflation period in Germany, is now being sought internationally in the interest of lowering costs by combating over-production by allocating markets and it follows that such arrangements involve price fixing. This effort is only in its beginning now and the future may bring forth many significant international associations.

Chemical Engineer Replaces the Aproned Apothecary in FINE CHEMICAL Manufacture

By A. A. BACKHAUS

Production Manager,
U. S. Industrial Alcohol Company,
Baltimore, Md.

AT A RECENT staff meeting of the Mayo Clinic, the following statement was made in a discussion: "In an organic compound the substitution of a hydrogen atom by a hydroxyl group (OH) decreases narcotic potency; as the hydroxyls are increased the potency is decreased." For the synthetic organic chemical industry this statement could be re-written thus: In an organic compound, the substitution of hydroxyl for hydrogen increases the economic potency of the compound; as the hydroxyls are increased, the economic potency is increased. Convenient examples are ethane, ethyl alcohol and ethylene glycol, or benzol, phenol and resorcinol. A review of the structural formulas of the compounds that come within the scope of the subject of this article will show the predominance and importance of the hydroxyl group. In fact "hydroxyl-chemical-engineering" might well be the subject of this brief discussion.

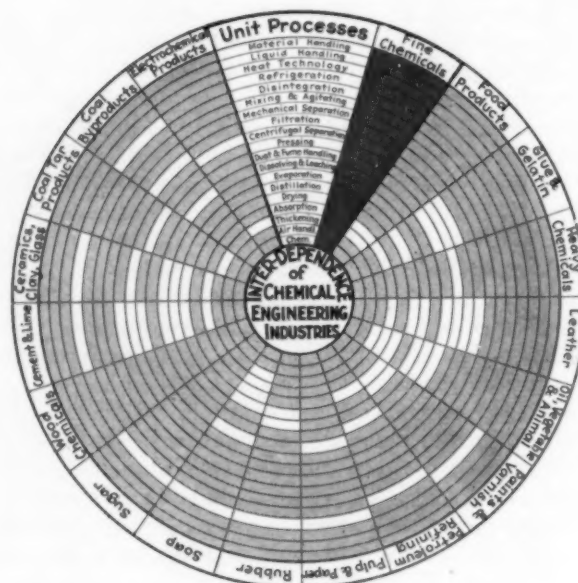
In the solvents industry practically all products of any importance contain, or are prepared from compounds containing the OH group, e.g., methyl, ethyl, propyl, butyl or amyl alcohols; glycerine; glycol; glycol ethers; or esters formed by combination of any one of these alcohols with acids such as formic, acetic, propionic, butyric, phthalic.

In the synthetic resin industry, phenol as well as methanol (for formaldehyde) are basic raw materials. Glycerine is required in ester gum and in other synthetic resins.

When the structural organic chemists have finally decided on the cellulose molecule it will probably be found to reveal a few hydroxyl groups. In fact the usefulness of cellulose in chemical manufacture is largely dependent upon its hydroxyls. It is the presence of this group that makes possible the nitrate and acetate derivatives, without which there would be no "movies," no durable automobile finishes or beautiful equipment for milady's dressing table.

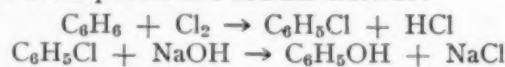
Photography, as we know it today, would be impossible without the hydroxyl group. Cellulose nitrate for films, itself a hydroxyl-containing compound, is dissolved in hydroxyl solvents; after exposure the negative is developed with other hydroxyl compounds. Sensitizers and light filters are compounds with hydroxyls well represented.

The major importance of the hydroxyl group in the field of fine chemicals being evident, it will be interesting to note that important recent developments in this field



are almost entirely confined to hydroxyl compounds.

The Hale-Britton process (*Ind. & Eng. Chem.*, vol. 20, pages 114 ff. (1928) for introducing an OH group on the benzene ring involves working pressures of 4,000 lb. per sq.in. The chemistry involved, in contrast to the chemical engineering, is rather simple. Benzol is chlorinated to chlorbenzol, and this reacts with caustic soda to form phenol and sodium chloride:



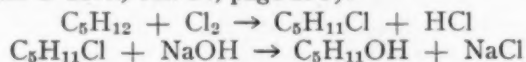
The fact that undesirable side reactions take place makes the problem interesting. At equilibrium a certain concentration of phenyl oxide is obtained. Satisfy the equilibrium by putting in this quantity of phenyl oxide before starting the reaction and practically quantitative conversion results. From that point on it becomes a matter of chemical engineering. To get uniform temperature and pressure conditions in continuous process necessitates detail of design and accuracy of construction appreciated only by those who have been through the mill.

The chemical combination of hydrogen and either CO or CO₂ results in the simplest of all organic hydroxyl compounds, methyl alcohol, better known as methanol. Within the past year, two plants have gone into the production of synthetic methanol in this country. In one case the combination of CO and H is used as a means of final purification of water or producer gas to

get hydrogen and nitrogen free of carbon monoxide for synthetic ammonia. In the other case, waste fermenter gases from butyl alcohol fermentation are utilized.

Operating pressures of 4,000 to 15,000 lb. per sq. in. are encountered in these operations. The engineering involved in the design of equipment and in the selection of materials of construction must be applauded by the entire profession. The fact that pressure conditions of this magnitude are quite within the realm of practicality, opens up a new field for the chemical engineer.

AMYL ALCOHOL from pentane has been made commercially within the past year. Here again the chemistry of the process is simple: chlorination of pentane and caustic soda hydrolysis of the resultant amyl chloride (*Chem. & Met.*, vol. 34, page 276).



From a laboratory standpoint the reactions have been known for a long time. Translating this process from the test tube to plant scale has been a time-consuming job and one on which over a million dollars has been expended. Not until the chemical engineer's job had been finished was the undertaking crowned with commercial success.

According to a recent patent (U. S. Pat. 1,627,040) the problem of recovering glycerine from fermentation mash has been solved. This should make possible large-scale production of fermentation glycerine.

From natural gas to ethylene glycol in five reels we hope will some day appear on the Bureau of Mines list of available industrial movies. Perhaps the most striking chemical engineering development in recent years is the production of glycol from natural gas. Here again we are dealing with the introduction of the hydroxyl group. Cracking natural gas to ethylene, isolating ethylene from the mixture, chlorinating to produce chlorhydrin, hydrolyzing to glycol and separating pure ethylene glycol, are the main steps in the process. Working out any one of the steps must have been difficult research. Yet all steps were carried through to successful laboratory conclusion and then the chemical engineer has put them into commercial production.

Petroleum, because of its abundance and cheapness, should become an important chemical raw material. Until very recently all work on the utilization of petroleum compounds had been in the direction of more complete combustion. In recent years efforts have been directed toward the manufacture of chemicals from petroleum. Again the hydroxyl group enlists the services of the chemist and the chemical engineer. Introducing the hydroxyl into petroleum compounds is not an easy task. More than one experimenter will bear testimony to that fact. However, the production of fine chemicals from petroleum is no longer a dream. Isopropyl, secondary and tertiary butyl, and amyl alcohols derived from petroleum have already appeared on the market. (See *Chem. & Met.*, vol. 33, pages 402-3 (1926).)

IT IS evident from the foregoing that the production of fine chemicals is not measured in minims. The notion that the fine chemicals factory consists of an aproned apothecary grinding away with his mortar and pestle in some back room has long since become outmoded. Large factories manned by technically trained chemists and chemical engineers turning out tons or thousands of gallons of fine chemicals is the new order.

The present status of fine chemicals manufacture in this country is the result of painstaking research put to work by the chemical engineer, with and by the consent of capital.

Fine chemicals often belie their humble origin. Through the medium of raw materials used, fine chemicals may be related to almost every other industry—coal, limestone, phosphate rock, sulphur, salt brines, iron, wood, cotton, sugar cane, crude oil, natural gas, air, water. These are among the basic raw materials upon which fine chemical manufacture depends.

The usual type processes of chemical engineering find their application in the wide range of operations involved in the manufacture of fine chemicals: solution, evaporation, crystallization, filtering, drying, sublimation, distillation, are all employed. Undoubtedly the type process most commonly met with in the manufacture of fine chemicals is distillation. That is true not only of the monohydric alcohols, but also of glycol, glycerine, esters, ether, phenol. In fact, the usefulness of distillation as a tool in "fine-chemical" engineering is coming to be more and more appreciated.

It is only within the last decade that the general principle of azeotropism has been applied in the practical solution of baffling chemical problems. It has been made use of to effect separations which cannot be made by ordinary distillation. Ethyl alcohol and water can be separated by ordinary distillation to produce a concentrate of about 97 per cent alcohol. By adding a third component such as hexane or benzol, distillation can be made to separate completely the water from the alcohol. Fractional distillation is generally thought of as a means of separating physical mixtures of liquids.

MODERN chemical engineering makes use of distillation in carrying to completion chemical reactions which ordinarily reach equilibrium long before the desired reaction is complete. As is well known, the interaction of an alcohol and an organic acid to produce the corresponding ester and water goes to a definite equilibrium point in accordance with the law of mass action. By the same law it is manifest that this reaction will proceed to completion if one of the products of the reaction, either the water or the ester, is removed from the reaction phase. The procedures, usually quite complicated, necessary to produce the desired result are covered by numerous patents.

The orthodox organic chemist "would not choose to run" (with apologies) an ethyl acetate synthesis starting with acetic acid consisting of 10 per cent acid and 90 per cent water. Nevertheless, during the past 10 years, millions of gallons of ethyl acetate have been made by the direct esterification of very dilute acetic acid solutions.

It would be ungracious indeed, not to give the equipment manufacturer credit for the part he has played in chemical engineering development in the fine chemicals field. The new alloys, bewildering as the number of them has been, have made possible some of the recent developments. Special steels had to precede processes operated at high pressures and elevated temperatures. Pyrex glass has come to the rescue in handling corrosive materials even in large-scale operation. Rubber linings and coatings are adding their mite. Electroplating rubber is a recent development in rubber technology which the users of chemical equipment in the fine chemical industry will watch with hopeful interest.

CHEMICAL ENGINEER'S BOOKSHELF

German Photomicrography

ATLAS METALLOGRAPHICUS. By H. Hanemann and A. Schrader. Borntraeger, Berlin, 1927. Price, Vol. 1 and 2, 14 M. 25 pfg.

Reviewed by PAUL D. MERICA

UNDER this title have recently appeared two volumes of a new German work which the authors describe as "a collection of photomicrographs in technical metallography." The authors specifically disclaim that this is a work on metallography but say that it is to contain descriptive reproductions of the "metallographic structures of all technically important metallic materials of construction," based upon a rich collection of material which has been accumulating for some seventeen years in the metallographic laboratories of The Charlottenburg Technische Hochschule.

The material is presented in loose-leaf form, contained in folders, each devoted to a different group of materials, and the descriptive text relating to the photomicrograph is conveniently placed on the page opposite them for ready comparison. This text contains the usual chemical and heat-treatment data together with pertinent comment on the features of structure disclosed in the reproductions. The first two folders or volumes deal with the structures, at 40, 150, 600 and 1,200 magnifications, of pure iron and of forged, unheat-treated steels up to 1.30 per cent carbon and the subsequent folders dealing with heat-treated and alloyed steel, with cast iron and with non-ferrous metals and alloys are promised for early delivery.

The value of such a pictorial collection of metallographic structures is obvious, particularly for those laboratories or those students who have had no opportunity to build up a representative collection and will serve as a sort of metallographic catalogue for reference and comparison. The clearness and beauty of the photographs, for which these authors have always been famous, should serve also to stimulate metallographers generally to a higher standard of photomicrographic work—a standard which is now possible to all but which unfortunately is not reached at all times. Metallographers will look forward with interest to the appearance of the further volumes and those who do not read German, to the possibility of its translation into English.

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The New Peele

MINING ENGINEERS' HANDBOOK. Robert Peele, editor-in-chief. Second edition. John Wiley and Sons, New York. 2,523 pages. Price, one volume edition, flexible, \$10; two volume edition, leather, \$12.

Reviewed by A. H. HUBBELL

The new "Peele" is up-to-date. In the ten years elapsed since the appearance of the first edition, some remarkable developments have taken place in various branches of mining engineering, notably in the application of geophysical science to the search for ore and in mechanical mucking and loading. Moreover, in this period costs have risen greatly; electricity has steadily been replacing steam for power purposes; hammer drills have supplanted reciprocating machines to a great extent;

and improvements have been numerous and marked in practically all equipment used for mining purposes. The need for a new edition of the handbook had therefore, become imperative. In meeting it so well, Professor Peele has scored a new achievement.

A journey, page by page, through the 2,500 pages of this volume, impresses the reviewer as never before, with the wealth of data here assembled. Truly a great service has been performed by Professor Peele and his collaborators. Facts, theory and illustration—all are much compressed and careful reading by the engineer or student is necessary, if the full value is to be extracted.

* * * *

Pyroxylin Enamels

PYROXYLIN ENAMELS AND LACQUERS. Second edition. By Samuel P. Wilson. D. Van Nostrand Company, New York. 253 pages. Price, \$3.50.

Reviewed by D. B. KEYES

TWO years have passed since the first edition of this book appeared. The production of lacquers in this country has more than doubled in this time. The production for the year 1297 will probably be 15,000,000 gallons, while the production for 1919 was only 500,000 gallons. There is no question that the lacquer industry is no longer an infant and its promoters should be congratulated not only on their remarkable success but also for the very great benefits received by the public from this development. Doctor Wilson's book has been a very real factor in this development. It still stands today the only treatise on the subject that is of commercial and practical value.

No review is necessary to bring this book to the attention of the public. Something can be said, however, regarding the new material in this second edition. The publisher has printed the new material in lighter type, a unique feature. The author has rewritten very little of the old text even the old formulas are repeated. As many of the formulas were of little practical value when they were first published it is probably quite all right to repeat them now. Much of the new material has been obtained from sales articles and not from first hand knowledge. Parts of the text give, therefore, a biased viewpoint, due to this source of knowledge.

Though there may be a little disappointment in Doctor Wilson's second edition, there is no question but his text is the best ever published and he is due the appreciation and thanks of the entire industry.

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Canadian Labor Studies

POSTPONING STRIKES. By Ben M. Selekman. Russell Sage Foundation, New York. 404 pages. Price, \$2.50.

This survey of the history and operation of the Canadian Industrial Disputes Investigation Act is justified by its author on the grounds that the attitude of Canadian labor toward the act has noticeably reversed in the past 8 or 9 years, having become distinctly favorable. The book is an expansion of a report prepared by the same author for the Russell Sage Foundation in 1916, revised

and brought up to date by the inclusion of statistics and accounts showing the operation of the act in Canada. The treatise is academically non-committal in evaluating the Canadian legislation in relation to possible American application, although one gathers that the author approves what he emphasizes as the most desirable feature of the act, its encouragement of conciliation. Compulsion, he concludes, is futile as compared with conference and negotiation under government auspices. As a conscientious, unbiased survey of Canada's experience with anti-strike legislation this work is a valuable reference. It will not, however, be selected by the Book-of-the-Month Club.

* * *

Oxidation and Reduction

OXIDATION-REDUCTION REACTIONS IN INORGANIC CHEMISTRY. By *Eric R. Jette*, Assistant Professor of Chemistry, Washington Square College, New York University. The Century Co., New York. 152 pages. Price, \$1.10.

Reviewed by H. V. ANDERSON

THIS is the first monograph to be presented that deals with a "comprehensive discussion of oxidation-reduction reactions for the student who has had enough training in chemistry to understand ordinary chemical terminology, but who has not had the benefit of a course in physical chemistry."

Oxidation-reduction reactions "are here discussed from two viewpoints, according to the method used for balancing the equations involved; these methods have been called respectively the 'valence change method' and the 'ion-electron method.'" The author, unhesitatingly, claims no originality for either of these methods. However, much can be said in favor of the decisive manner in which this subject has been developed by the author.

The chapter on "Oxidation and Reduction in Relation to Atomic Structure," deals with the modern views on atomic structure, the modern definition of oxidation and reduction and the grouping of reactions in the dry state between solids or between gases as non-ionic reactions and the grouping of reactions taking place in aqueous solution between dissolved substances, as ionic reactions.

The chapters dealing with the balancing of equations for non-ionic reactions using the "valence change method" is illustrated with several examples. Then follows a detailed discussion of the "ion-electron method" for balancing ionic reactions, the basis of which is found in electro-chemistry, and the advantages this method has over the valence change method for this type of reaction. The several chapters on the applications of the "ion-electron method" involving "the effect of the hydrogen ion concentration," "the effect of diminishing the concentration by means of insoluble and weakly dissociated compounds," "the formation of complex ions," are particularly instructive. Each individual treatment of the various types is considered with the knowledge of present day facts.

"Throughout those portions of the book dealing with specific examples of oxidation-reduction reactions, emphasis has been laid upon the initial substances and the final products of the reaction, rather than upon the mechanism by which the final state is reached."

As an appendix follows a discussion of the thermodynamic basis of the "ion-electron method" applicable "to those matters which have a direct bearing upon the topics discussed in this volume." There is also a list of 235 reactions which exemplify the various types of reactions encountered in inorganic chemistry and qualitative

analysis for use as exercises for the students. Finally, useful tables of oxidation-reduction potentials are inserted to act as a further guide in the treatment of this important type of chemical reaction.

The author, in this treatise, has made a valuable contribution to the literature and one which is manifestly interesting.

* * *

Molecular Physics

MOLECULAR PHYSICS. By *J. A. Crowther*, M.A., Sc.D. Blakiston's Son & Company, Philadelphia, Pa. 4th edition. 1927. 202 pages. Price, \$2.50.

Reviewed by HUGH S. TAYLOR

THIS little book recapitulates in 200 pages the modern theory of the structure of atoms, beginning with a historical survey, describing the developments of the ideas concerning electrons, ions, and the nuclear atom. Then it takes up the concept of the nuclear atom and the various theories of valency which may be based upon such a concept. It passes thence to a discussion of the atom in vibration, considering spectra, with a discussion of classical quantum theory. The book concludes with the modern work on the atom in dissolution. The book is simple, readable, with a minimum amount of mathematical treatment. It is a suitable book to put into the hands of the better student in classes of general chemistry and may well form an introductory outline of the subject for more advanced students. That it is an eminently readable book and of wide appeal is evident from the fact that this represents the fourth edition of the book.

* * *

Chemistry of a Fruit Industry

THE BANANA: ITS HISTORY, CULTIVATION AND PLACE AMONG STAPLE FOODS. By *Philip Keep Reynolds*. Houghton Mifflin Company, Boston and New York. 172 pp. Price, \$2.00.

Reviewed by M. W. WEISS

IT IS remarkable that although the banana has been an important staple food in the United States for more than a half century, this is the first American book to deal adequately with the subject.

It covers in an interesting and highly readable manner the botanical relations of the edible bananas to the other members of the banana family, the early history of the fruit in the various regions where it is cultivated, and the development of the vast industry which now supplies bananas to all parts of the world. The chemical engineer will be particularly interested in the chapters which describe the ingenious and elaborate methods which have made it possible to ship the green fruit great distances over the ocean from the tropics, to ports on the Atlantic coast, and then by rail to points far inland. During transportation the fruit must be well ventilated and maintained within a narrow range of temperature in order to check the ripening process until the bananas reach the ripening rooms of the jobber at the point of consumption. The problem is complicated by the fact that bananas generate heat and evolve carbon dioxide, both of which accelerate ripening. The modern banana steamship is therefore a triumph of chemical engineering.

The chemist and particularly the dietitian will find the chapter on the food value of the banana instructive and helpful. There is a review of the scientific evidence which places this fruit in a leading place among the staple foods of our diet, a position which it occupies on

account of its high food value and vitamin content, its relative cheapness when compared with other staple foods on a calorie basis, its digestibility, and its general adaptability to human requirements. The dietetic value of the banana is impressed upon the reader by many quotations from the research work of eminent physicians and dietitians who have found this fruit to be particularly suitable as a food for children.

The last chapter, entitled "An Ancient Empire Retrieved," describes the economic and social significance of the banana industry to the Central American tropics. The introduction of modern methods of sanitation, communication, and transportation, which are essential to the production of bananas for a world market, is doing much to rehabilitate the Caribbean countries.

There is an excellent bibliography divided into the following parts: I. General; II. Botany and History; III. Chemistry and Food Value. The last section is exceptionally complete and will be especially useful to chemists, dietitians and others interested in original sources of information. The book is well illustrated and in general form is well adapted to make interesting reading.

* * * *

ENGLISH FOR ENGINEERS. By S. A. Harbarger. Second Edition. McGraw-Hill Book Company, Inc., New York. 300 pages. Price, \$2.

In its initial appearance five years ago, this book sought to stimulate the engineer to a profitable improvement in his various applications of English. Especial stress was laid on the several types of letters that might concern him, but sections on technical abstracts, reports, reviews, and articles, and on recreational literature were also included. This new edition represents a revision containing an added amount of illustrative material, extended lists for collateral reading, and an appendix with suggestions for practice writing.

* * * *

Two Popular Analytical Texts

TECHNICAL METHODS OF ORE ANALYSIS. By Albert H. Low. John Wiley & Sons, Inc., New York. 348 pages. Price, \$3.50.

The tenth edition of Doctor Low's versatile guide for the analyst who may be called upon to determine the quantity of almost any metal in almost any ore will be welcomed in many laboratories. It is an entirely practical, bread-and-butter type of book, with quantitative and qualitative methods merrily mingled, devoid of references to theory and consequently, condemned by many educators as "cook-book" chemistry. Nevertheless, its popularity proves that it has its place and fills it well.

* * * *

ALLEN'S COMMERCIAL ORGANIC ANALYSIS, VOL. VI. Fifth Edition. Edited by Samuel S. Sudler, Elbert C. Lathrop, and C. Ainsworth Mitchell. P. Blakiston's Son & Company, Philadelphia. 1928. 658 pages. Price, \$7.50.

This sixth volume of the series, dealing successively with colorimetry, dyes, the synthetic dyestuffs, and their analysis, now appears in an entirely new and revised form. It is made up largely of two long articles, "Dyes and Colouring Matters," by Dr. Hans Edward Fierz-David of Zurich, and "Synthetic Dyestuffs," by Dr. A. W. Joyce of New York, which cover the field of identification by treating the substances respectively as chemical entities and as unions of characteristic groups. The remaining two articles are freshly written, in harmony with the improved arrangement of the material.

Recent Foreign Books

HÜTTE. Taschenbuch für den praktischen Chemiker. Wilhelm Ernst & Sohn, Berlin. 898 pages. Price, 28M.

A convenient comprehensive handbook for the chemist in industry. It exhausts briefly the field of applied chemistry, giving desirable related data on unit operations, chemical constants and calculations. A similar work in English would be very useful.

* * * *

MATERIALPRÜFUNG MIT RÖNTGENSTRAHLEN, (Testing Materials with X-rays). By Dr. Richard Glocker. Technische Hochschule, Stuttgart. Julius Springer, Berlin. 377 pages, 256 illustrations. Price, 31.50 M.

Reviewed by G. L. CLARK

This new book on the applications of X-rays is primarily concerned with X-ray metallography. The distinguished author has been one of the most intensive experimenters in this field and many of the important methods of interpretation of X-ray diagrams for metals have been due to him. This is particularly true for the effects for fabrication, heat treatment and recrystallization of metals. The book, therefore, supplements very excellently the monumental handbook on applied X-rays recently published by Mark. Most of the treatment on the fundamentals of X-ray science can be found in previously published books but the chapter on the interpretation of fiber structure alone justifies the appearance of this excellently written monograph. It should be in the library of the rapidly growing number of people who realize that X-rays are a most valuable tool in the solution of many technical problems.

* * * *

KOKEREI-UND GASWERKSÖFEN. By L. Litinsky. Wilhelm Knapp, Halle, Germany. 336 pages. Price, 21 M.

This volume is one of a series of monographs intended to cover the field of combustion and fuels. Its particular objective is to present a comprehensive study of coke ovens and operations. Introduced by a short historical sketch, it proceeds to describe the various oven designs of any practical significance and finally goes over to a consideration of the numerous subordinate problems of coking technology. Both coke-ovens proper and gas-ovens are included in the treatment, and a generous selection of illustrations and tables supplements the text.

* * * *

DISTILLATION DES COMBUSTIBLES A BASSE TEMPERATURE. By R. Courau and Henri Besson. Gaston Doin & Cie, Paris. 356 pages. Price, 40 Fr.

General treatment of low-temperature distillation of combustibles, oil and coal in particular. The subject is introduced from the theoretical standpoint, giving discussions of the structure of coal and hydrocarbon oils. The latter, and most interesting section of the volume is devoted to a study of the economic phases.

* * * *

LEICHTE KOHLENWASSERSTOFFOLE. By Dr. Max Naphtali. M. Krayn, Berlin. 562 pages. Price, 42 M.

A compilation of the common light hydrocarbon oils and the more modern methods of obtaining them. It covers the oils derived from the various cracking processes, from coal, and from gases. The text discusses the respective patents, and 50 pages of illustrative graphs are appended.

* * * *

The Chemical Age, of London, has issued "The Chemical Age Year Book, 1928," combining the services of a diary and a directory of useful chemical and engineering data.

Selections from Recent Literature

SETTLING FILTER. K. Keller. *Chemiker-Zeitung*, Feb. 8, pp. 111-3. Illustrated description of the Seitz filter, in which a large number of filter elements (of wire gauze or the like) are placed vertically and very closely spaced. The filtering medium is a fine asbestos fiber deposit on the gauze. A special corrosion resisting construction is used where needed. A wide range of possible applications is cited.

ELECTRIC FURNACES. E. Löwenstein. *Chemische Fabrik*, Feb. 15, pp. 77-8. Illustrated description of the latest design of Tammann furnace for high temperature work. A power-temperature curve chart is shown for the range up to 60 kw. and 3,500 deg. C. The Elektro-Schaltwerk furnace is also briefly described. It differs from the Tammann design in that the current goes in and out at the same end of the heating tube, the other end being free to move.

PERFORATED SHEET METAL. Adolf Ergang. *Chemische Fabrik*, Feb. 15, pp. 78-80. Special designs of perforated sheet metal, useful with or instead of wire fabrics, are described. Special applications include use with cathode wire gauze in the Siemens-Billiter electrolytic apparatus; as filter cloth carrier in various types of filters, etc. Illustrated.

PHOSGENE. M. and L. Jacque. *Chimie et Industrie*, Jan., pp. 24-38. Manufacturing methods and equipment used in refining the raw materials and producing pure COCl_2 are described. Diagrams are shown of gas washers, mixers, catalyzer constructions and a plant layout. Vapor pressure curves are shown for phosgene, its component gases and certain solvents.

HYDROCHLORIC ACID. *Industrial Chemist*, Feb., pp. 75-6. Due to the practice of marketing in small containers, the cost of conveying and handling alone may be from one to two thirds of the ultimate cost of hydrochloric acid. Of the various materials which have been tried for large scale handling and storage, one of the best is the rubber lined metal tank. A storage system on this basis, about to be erected in England, is described and illustrated.

SILICA GEL. H. G. Grimm and H. Wolff. *Zeitschrift für angewandte Chemie*, Jan. 28, pp. 98-107. Of the binary liquid mixtures for which separation by distillation is difficult or impossible, many can be partly or entirely separated by silica gel. The mixture may be distilled through silica gel, or the mixed vapor may be passed through, or the liquid may be allowed to drip through a layer of the gel. The last is the preferred method, for which proper operating conditions are stated. In general, the greater the difference in the heats of wetting of the gel by the two components, the more effective the separation.

FATIGUE OF STEEL. A. Pomp. *Chemische Fabrik*, Feb. 1, pp. 53-4. The behavior of steels (0.046 to 1.0 per cent C.) under prolonged stress at 300-500 deg. C. was studied. Elongation-time curves under different loads are shown. The purpose of the investigation was to find a basis for calculating stress limits to be specified for structural steels for such uses as ammonia synthesis and other high temperature, high pressure gas reactions.

SULPHITE COOKING. W. H. Birchard. *Canadian Chemistry and Metallurgy*, Feb., pp. 31-4. Chip condition, temperature cycle and acid are discussed as factors in successful cooking. Penetration is of great importance; cooking temperature must be carefully controlled to avoid blocking of the pores by resins. Precipitation on the fibers is chiefly in the form of the hydroxide of the base; thus there is the probability of alkaline hydrolysis after the sulphonation.

HANDLING MATERIALS. Karl Schiebl. *Chemiker-Zeitung*, Jan. 4, p. 10; Jan. 18, p. 52; Jan. 25, p. 72; Feb. 1, pp. 91-2. An illustrated description of mechanical methods and equipment for moving solids, liquids and gases from one place to another in chemical and industrial plants. Among the items are portable and stationary conveyors and installations of hydraulic and pneumatic equipment.

FILTER PRESSES. Scheifele. *Farbe und Lack*, Feb. 1, p. 48. Methods of use of filter presses, to get the best results, are discussed. Precautions against corrosion, failure of filter cloths and other troubles are recommended. Advantages of such filter media as silica gel are enumerated.

CELLULOID ARTICLES. A. Bahls. *Kunststoffe*, Feb., pp. 25-8. A description of methods, tools and machinery for making shaped articles of celluloid. Illustrations show blanks for combs, trays, soap dishes, hair ornaments and the like. Methods of cutting the blanks and pressing or molding the finished articles are discussed.

NEW DRIER. M. Weiss. *Chemische Fabrik*, Feb. 8, pp. 65-6. A new design for a rotary drier. The material passes successively over projecting plates or shelves to facilitate exposure to the hot gases. These shelves may be in separate units of the drier and may be of stoneware, cast iron or other cast material which may be chosen according to the chemical nature of the material to be dried. The drier is applicable to most materials and effects a saving or simplification in many refining processes, e.g. in drying salt.

ACID SOAPS. Max Hartmann and H. Kägi. *Zeitschrift für angewandte Chemie*, Feb. 4, pp. 127-30. In an effort to fill the long-standing need for a soap which would yield no alkali by hydrolysis, certain fatty acid derivatives of substituted ethylenediamines have

been developed. The generic name "sapamines" is applied to these compounds; letters are added to indicate whether a given member of the series is a hydrochloride, acetate, lactate, etc. There are numerous potential uses for acid soaps in the chemical industries, particularly in textile processing and like processes where a detergent or emulsifying agent is needed.

NITRATING CELLULOSE. E. Berl and E. Berkenfeld. *Zeitschrift für angewandte Chemie*, Feb. 4, pp. 130-2. Progress in the technical control of nitration of cellulose to give certain specified properties has been much hampered by the false statement, common in the literature, that properties of the product are governed by the composition of the nitrating acid. This factor in reality has relatively little influence. The ratio of cellulose to acid (by weight) is important, and other factors also need watching. The final composition of the nitrating acid is much more significant than the initial composition. Viscosity and N content curve charts are shown for nitration of linters and wood cellulose.

SALT CAKE FURNACE. Friedrich Böhm. *Chemiker-Zeitung*, Feb. 4, pp. 101-2. A description of the construction and operation of the Mannheim furnace for making Na_2SO_4 and HCl . Cast iron muffles give very satisfactory acid resistance in the bisulphate furnace, but not for the higher temperatures encountered in furnaces for treating NaCl with H_2SO_4 . For these, stoneware muffles must be used.

EDIBLE OILS. H. M. Langton. *Industrial Chemist*, Jan., pp. 26-30. A description of methods of bleaching and deodorizing fatty oils. The oxidation methods (air blowing, hydrogen peroxide, dichromate and acid methods) are preferred to reduction. Adsorptive bleaching also has advantages. For deodorizing, distillation with vacuum or superheated steam is advocated. A plant layout for complete refining is illustrated.

LACQUERING METERS. *Farbe und Lack*, Jan. 18, p. 29. Illustrated description of the application of quantity production methods to the manufacture of electric meter parts requiring a lacquer coating. Rapid but controlled drying of the lacquer is a feature.

WOOD IMPREGNATION. Robert Nowotny. *Zeitschrift für angewandte Chemie*, Jan. 14, pp. 46-9. In the treatment of wood with water soluble preservatives, if the moisture content of the wood is properly controlled there is considerable penetration of the preservative into the interior of the wood. This is particularly in connection with the "cobra" process of applying the preservative, effective penetration being necessary to successful treatment.

CERAMIC FILTERS. A. Simon and W. Neth. *Chemische Fabrik*, Jan. 25, pp. 41-9. Quantitative experiments were made to compare the chemical corrosion resistance of various glass, quartz and porcelain porous filters. The reagents included H_2O , NaOH ,

HCl, H_2SO_4 , NH_4OH and the like. Resistance was satisfactory except in the case of hot alkalis, for which quartz showed better resistance than glass or porcelain. Porcelain is preferable when ignition is necessary.

LACTOSE. Otto Ugnade. *Chemiker-Zeitung*, Jan. 25, pp. 69-71. In the production of lactose from whey, current (German) practice in plant design and layout leaves much to be desired. Though the processes are not strictly comparable at all stages, the best practice in beet sugar production could give some valuable lessons to the lactose producers. A recommended plant layout for lactose production is illustrated and discussed.

ALUMINUM-COPPER ALLOYS. Pierre Chevenard and Albert Portevin. *Comptes rendus*, Jan. 16, pp. 144-6. The volume change which first accompanies the hardening of light Al-Cu alloys is due to precipitation of Al_2Cu , which has a smaller coefficient of expansion than the solid solution of Cu in Al. The volume change which occurs above 170 deg. in the hardening process is due to some other reaction, not yet known with certainty but most probably not analogous with the martensite state in steels.

ANTHRAQUINONE DYES. E. Schwenk. *Chemiker-Zeitung*, Jan. 14, pp. 45-6; Jan. 21, p. 62. The most important alkali fusion processes for making anthraquinone dyes are discussed. It is shown that, while these processes have much importance in vat dye manufacture, their descriptions in patent specifications are often quite inadequate and further investigation is needed to improve yield or quality or both.

CENTRIFUGAL SPINNING. Johann Eggert. *Chemiker-Zeitung*, Jan. 18, pp. 49-50. Air friction is a major cause of the rather large power requirement for driving the cans used in spinning viscose. Reducing the surface area by 25 per cent (from about 1,200 to about 900 sq.cm.) reduces the power requirement, sometimes as much as 50 per cent; but area is not the only factor in air resistance. Shape must also be considered. A design has been worked out which is mechanically excellent, but hardly cheap enough. Further work is invited.

ALUMINUM EQUIPMENT. H. Buschlinger. *Chemische Fabrik*, Jan. 18, pp. 29-31. A discussion of the use of acid resisting and special Al alloys in the fermentation industries and in the manufacture or handling of nitric acid, drugs, fats and waxes, inorganic and organic dyes, ammonium sulphide and various food products such as fruit juices.

CASEIN. *Industrial Chemist*, Jan., pp. 20-5. A description of the production of lactic, rennet and acid caseins. Photographs are shown of the machinery used in magnetic cleaning and in the grinding and sifting of casein to prepare it as a raw material for making adhesives, paints, plastics and food preparations. Properties are discussed as related to use.

Government Publications

Prices indicated are charged by the Superintendent of Documents, Washington, D. C., for pamphlets. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for issue.

Magnesite. Report of the United States Tariff Commission to the President of the United States. With Appendix Proclamation by the President. 5 cents.

Costs of Producing Sugar Beets, Part X—United States. U. S. Tariff Commission. 20 cents.

German Chemical Developments in 1927, by William T. Daugherty. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 532. 10 cents.

Leather Production and Trade of Canada, by J. Schnitzer. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 528. 10 cents.

Trade Association Activities, by Irving S. Paull, J. W. Millard, and James S. Taylor. Bureau of Foreign and Domestic Commerce Domestic Commerce Series 20. 75 cents.

Commercial Survey of the Southeast. Bureau of Foreign and Domestic Commerce Domestic Commerce Series 19. \$1.00.

List of Bulletins of the Agricultural Experiment Stations for the Calendar Years 1925 and 1926—Supplement 3, by Catherine E. Pennington. U. S. Department of Agriculture Department Bulletin 1199. 10 cents.

Chemistry and Analysis of the Permitted Coal-Tar Food Dyes, by J. A. Ambler, W. F. Clarke, O. L. Evenson, and H. Wales. U. S. Department of Agriculture Department Bulletin 1390. 10 cents.

Hydraulic Classification, Its Theory, Mechanical Development, and Application to Ore Dressing, with a Chapter on Methods of Determining the Densities of Liquids and Ore Pulpes, by A. W. Fahrenwald. Bureau of Mines Technical Paper 403. 15 cents.

Analyses of Arkansas Coals. Bureau of Mines Technical Paper 416. 5 cents.

Analyses of Indiana Coals. Bureau of Mines Technical Paper 417. 10 cents.

Consumption of Reagents Used in Flotation, 1926, by Thomas Varley. Bureau of Mines Serial 2852.

The Determination of Carbon Monoxide in Mines with the "Iodine Pentoxide" Detector, by G. S. McCaa and John A. Davis. Bureau of Mines Circular 6057.

Mineral production statistics for 1926—Separate pamphlets from Bureau of Mines on: Rare Metals—Cobalt, Molybdenum, Nickel, Tantalum, Titanium, Tungsten, Radium, Uranium, and Vanadium, by Frank L. Hess, 5 cents; Silver,

Copper, Lead, and Zinc in the Central States, by J. P. Dunlop and H. M. Meyer, 10 cents; Stone, by A. T. Coons, 5 cents; Anthracite, by F. G. Tryon and H. L. Bennit, 10 cents.

Consumption of Explosives. Statistical Statement from the Bureau of Mines giving figures for December, 1927, including preliminary figures for the year 1927.

World Petroleum Production in 1927. Bureau of Foreign and Domestic Commerce Petroleum Production Statistics No. 178 S.

The Study of an Intermediate Base Crude Oil, by H. M. Smith. Bureau of Mines Serial 2837.

The Sulphur Content of Commercial Motor Fuels, by A. J. Kraemer, E. C. Lane, and C. S. Luce. Bureau of Mines Serial 2843.

Properties of California Crude Oils—III. Additional Analyses, by A. J. Kraemer. Bureau of Mines Serial 2846.

Analyses of Crude Oils from the West Texas District, by A. J. Kraemer, Peter Grandone, and C. S. Luce. Bureau of Mines Serial 2849.

Mineral production statistics for 1927—preliminary mimeographed statements from Bureau of Mines on: Lead and Zinc, Copper, Lead and Zinc, Lime, Manganese, Copper, Iron Ore, Sand and Gravel.

Insecticides (Calcium Arsenate, Lead Arsenate, and Paris Green) Year ended August 31, 1927. Mimeographed statement of the Census of Manufactures, Bureau of the Census.

The Clay Products Industries and Sand-Lime Brick, 1926. Pamphlet of Bureau of the Census. 5 cents.

Gold and Silver in 1925. Bureau of Mines Mineral Resources pamphlet. 10 cents.

Mineral production statistics for 1926—Separate pamphlets from Bureau of Mines on: Abrasive Materials; Asbestos, by B. H. Stoddard; Clay, by Jefferson Middleton; Feldspar, by Jefferson Middleton; Gypsum, by R. M. Santmyers and Jefferson Middleton; Graphite, by Jefferson Middleton; Lime, by A. T. Coons; Magnesium and Its Compounds, J. M. Hill; Mica, by B. H. Stoddard; Phosphate Rock; Potash, by A. T. Coons; Slate, by A. T. Coons; Talc and Soapstone, by B. H. Stoddard; Mercury, by J. W. Furness; and Zinc, by Amy Stoll, 5 cents each; Iron Ore, Pig Iron, and Steel, by Hubert W. Davis; Lead and Zinc Pigments and Salts, by A. Stoll; Manganese and Manganiferous Ores, by J. W. Furness. 10 cents each.

Commercial Stocks of Coal, January 1, 1928. Statistical statement issued by the Bureau of Mines in co-operation with the Bureau of the Census.

Marketing of Crude Rubber, by E. G. Holt. Bureau of Foreign and Domestic Commerce Trade Promotion Series 55. 45 cents.

THE PLANT NOTEBOOK

an exchange for OPERATING MEN

Muffle-Type Pot Furnace

By E. P. BARRETT AND C. E. WOOD
Metallurgist and Assistant Chemist respectively,
North Central Experiment Station,
U. S. Bureau of Mines

Certain investigations at the North Central Experiment Station of the United States Bureau of Mines, University campus, Minneapolis, necessitated the use of a muffle-type furnace in which temperatures of 1,650 deg. C. could be maintained. The ideal equipment for this work would have been an electric resistor furnace but none was available. It was impossible to obtain these temperatures in the ordinary type of gas-fired pot furnace using city gas of 550 B.t.u. value. The use of oil proved advantageous, in that it produced the necessary temperature and was much more economical than gas as it cost only about one-fourth as much. The only crucibles that could be used in this investigation were made from graphite electrodes, and it was necessary to protect them from the oxidizing atmosphere within the furnace. Muffles made from several kinds of refractory material were tried. For various reasons all failed but one. This was made of Carbofrax cement No. 3, painted with alundum cement to prevent oxidation of the silicon carbide. Another advantage offered by the silicon carbide was that of high heat conductivity, which no doubt gave a more uniform temperature within the muffle.

The apparatus consisted of the fur-

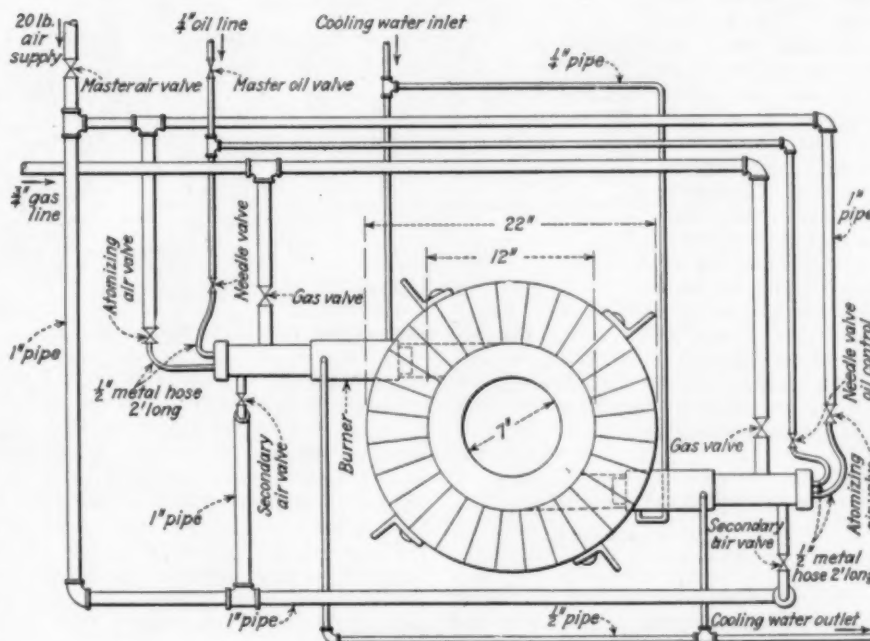


Fig. 2—Plan of the Furnace and Piping

nace proper, the burners, and the hollow core or muffle. These are shown in Figs. 1 and 2. The furnace proper was a sheet-iron shell lined with the highest grade of firebrick. It has been suggested that high-aluminous brick be used instead of the fire brick. The fire-brick lining proved to be good after more than 200 hours operation in periods of 3 to 8 hours each. The hollow core or muffle

was hand-made from Carbofrax cement No. 3 in a split mold made of 6-in. pipe. The air-dried muffle was painted inside and out with alundum cement of the consistency of thick cream. It was necessary to repaint the muffle on the outside from time to time with alundum cement, as the coating became thin in spots.

The water-cooled combination gas or oil burners were constructed from pipe fittings. They were the heart of the furnace and were developed by the authors to meet the requirements of these tests. Each burner consisted of

a water-cooled shell to which connections were welded for gas and secondary air, and an atomizing head with oil and air connections, so arranged that the head could be moved forward or backward in relation to the inner ends of the burner shell. The best operation of the burners was obtained with the atomizing head about four inches back from the inner end of the burner shell. The common method of employing a small stream of air at right angles to a jet of oil was used to atomize the oil. This air-oil mist was surrounded by six streams of secondary air so that the proportionate amounts of oil mist and air could be regulated to give a short clean flame. Two burners were used on this furnace. Fig. 3 shows that each burner had two independently regulated air supplies, one for the atomizing air and the other for the secondary air. The air and oil lines were fitted with master valves, since it was necessary to shut off the burners whenever a crucible was introduced into or removed from the furnace or whenever temperature readings were taken with an optical pyrometer. The advantage of using the master valves was that the burners could be shut off quickly and as quickly started again without disturbing the adjustments of the air and oil supplies to the burners.

Gas oil, 30 to 34 Bé, under pressure

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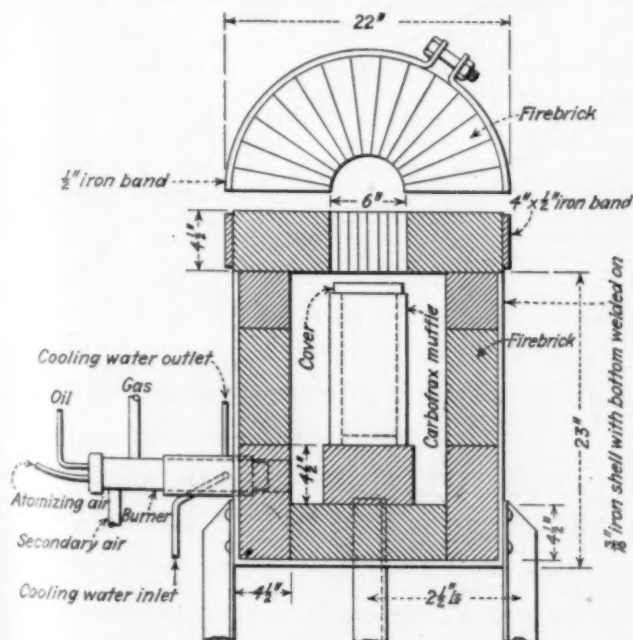


Fig. 1—Sectional Elevation of the Furnace

of about 10 lb. and air under 17 to 25 lb. pressure were used. In starting the burners or for low-temperature operation the burners were operated on city gas. In such cases the atomizing heads were pulled backward as far as possible. This was also true when the burners were to be shut off for more than a few minutes so that the head would not become heated to a temperature sufficiently high to carbonize the oil and thus close the oil hole. Observation of these precautions gave perfect operation of the burners.

The writers believe that this type of furnace construction may be of frequent application in industry.

Copper Welding

BY JAMES SILBERSTEIN
Wilkesburg, Pa.

The oxy-acetylene welding of copper does not receive the recognition and application which it merits. The reason for this can be traced to failures and uncertain results but which have not been thoroughly investigated and the causes determined. On the other hand,

the brazing of copper is so firmly entrenched as a method of joining that it is only with great difficulty that the superior method of welding by the use of acetylene can displace brazing. Many welders attempt to weld copper by methods similar to those used for steel and obtain very poor results. For this reason it is necessary to grasp the essential technique required for obtaining sound welds in copper with any degree of certainty.

Copper is an excellent conductor of heat. It is therefore necessary to concentrate the welding flame on the smallest area possible for otherwise too much

copper will melt away. But it has also been established that copper welds made with the correct procedure fail close to the weld and the cause for this has been found to lie in the oxygen content of the copper. The reducing gases of the welding flame combine with the oxygen in the copper and result in a weakening of the grain structure which produces brittleness. Copper which is completely deoxidized is not rendered brittle on welding with the oxy-acetylene flame. Such copper, which may be termed "Weldable copper" is a commercial product and is available in the form of sheets, tubes and pipes. The necessity for using deoxidized copper applies only to cases in which the welded joints are to be worked or have to withstand considerable stresses in service, which, however, is the usual case in copper smithing. In certain classes of work where the joints do not have to be worked in any way and no stresses have to be withstood, particularly bending stresses, the ordinary common grade of commercial copper may be used safely without this objection.

Pipe Fittings

Where screw fittings are required in the pipe lines of chemical plants, it has been found best to use tees in place of elbows and crosses in place of tees. The extra opening in each case is closed by a screw plug. This permits easy cleaning or draining when necessary and also makes it possible to tap into the line without breaking the piping or connections, thus saving both time and expense.

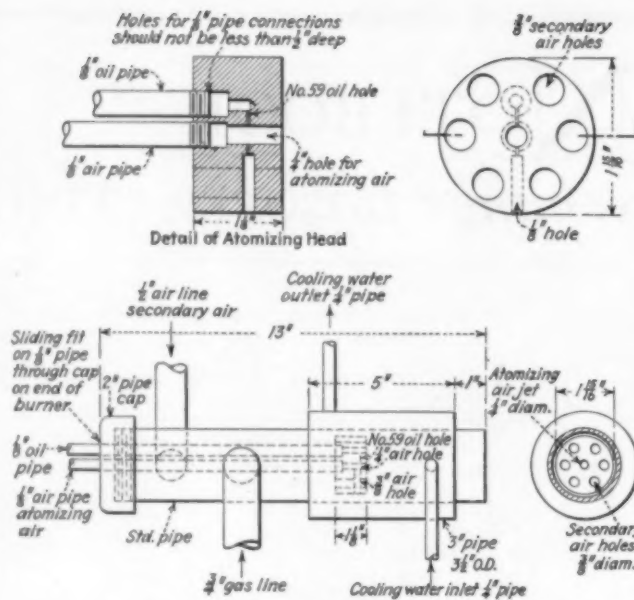
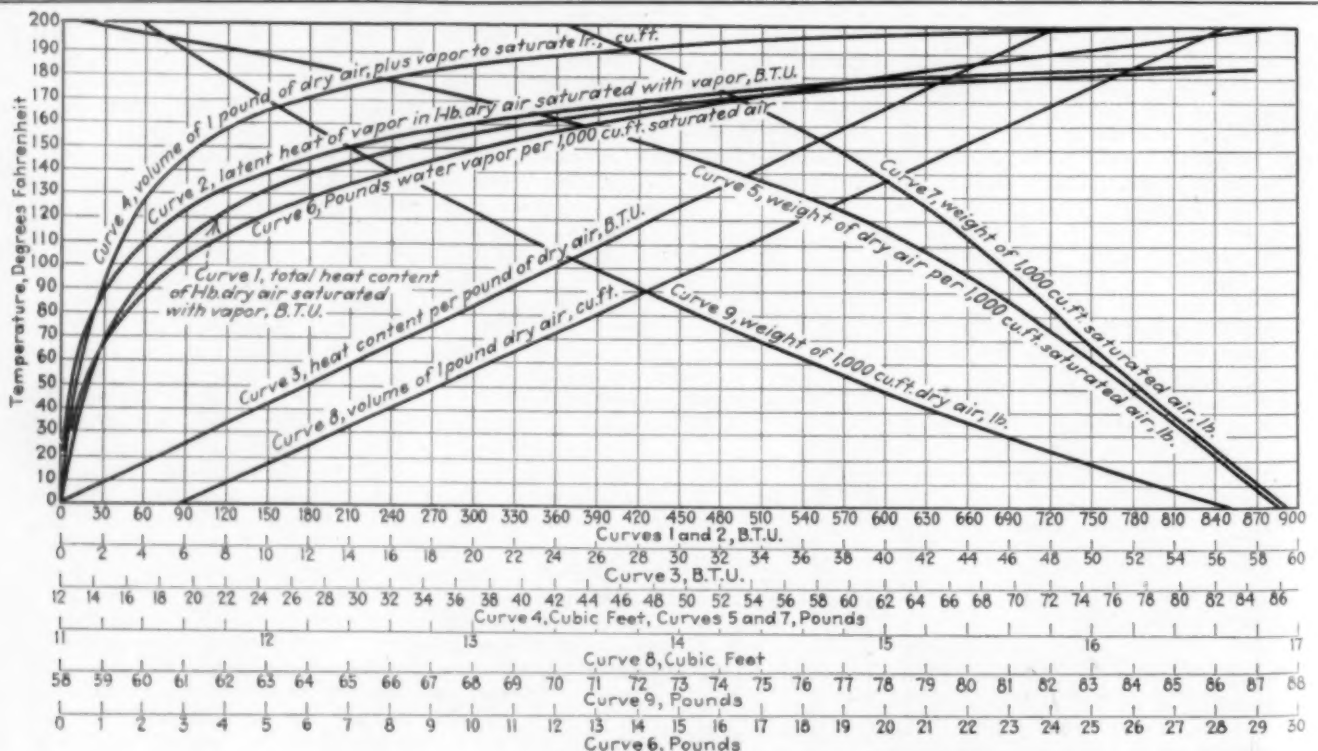


Fig. 3—Details of the Burner Construction



Data from tables in 5th Edit. Gebhardt's "Steam Power Plant Engineering"

Properties of Air

Curves for air properties simplify the calculation in connection with such processes as drying, ventilation and evaporation.

BY L. G. JONES,
Baltimore, Md.

EQUIPMENT NEWS

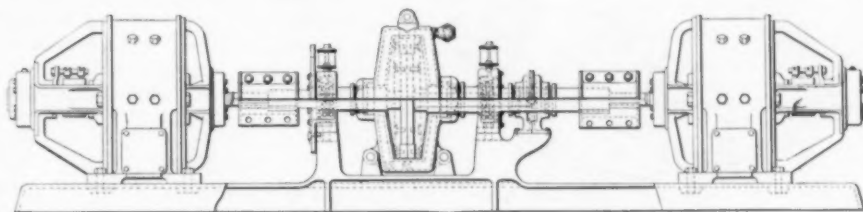
from MAKER and USER

New Colloid Mill

A new type of colloid mill has been placed on the market by the U. S. Colloid Mill Corporation, East Avenue and 13th St., Long Island City, N. Y. The mill, as shown in the accompanying cut, consists of two adjacent, oppositely driven rotors mounted within a casing. The casing is cored to serve as a water jacket and is split for easy removal when cleaning is required. The rotors are mounted on shafts running on double rows of ball bearings, direct connected through rigid couplings, each to an electric motor. The right-hand shaft is hollow for half of its length and serves as one of the fluid passages. Fluid connections are made to the rotor chamber and to a collector on the shaft, shown between the right-hand ball race and the coupling.

This mill is said to be the only double rotor machine on the market. The advantage claimed for the arrangement is that the effective speed of the pair of rotors is twice that of either one alone, and can be twice that mechanically possible for a single rotor. The result is said to be a reduction in shaft stresses and in wear and maintenance and an increase in the productive capacity of the mill.

The clearance between the rotors is adjustable by means of an outside micrometer screw. Material may be passed through the rotors in either direction, that is, through the shaft and out between the rotors, or vice versa. As a result of the two rotors moving in opposite directions at the same speed, there is said to be no pumping action of the mill even when the flow of fluid is from inside to out. It is necessary to force the fluid through the mill with an external pump under all circumstances. The advantage claimed for this is that material may be held in the mill as long as necessary to obtain complete homogenization or disintegration and dispersion, without the necessity for using a battery of mills or making several passes through the same mill.



Two-Rotor Horizontal Colloid Mill

The rotors in the standard machine are 13 in. in diameter and consist of hardened and interchangeable steel rings mounted on disks at their peripheries. The width of the ring surface is regulated by the type of material being processed. Rings are supplied plain for use in making emulsions, or dentated or serrated around the inner periphery for use in grinding and dispersing fibrous material. The standard mill is said to have a capacity ranging from 500 to 1,000 gallons per hour depending upon the viscosity of the material being processed. Special linings such as Monel metal or chrome or nickel plate may be supplied if desired.

with a motor and chain drive, or for any other method of driving required. It is adapted to be used with fuel oil or gas, and is provided with an independent exhaust chamber which discharges into any available flue connection. It is claimed that it may be used without the exhaust chamber or flue connection if desired.

In certain cases a deflector is installed over the exhaust end of the heating tube and the hot gases are directed back to the drier between the tube and the casing, thus giving a double pass with resultant increase in efficiency. A special screen section may be supplied for the discharge end of the shell.

The suspension of the central heating tube is such that it is claimed there is no possibility of distortion. Driers may be provided in sizes ranging in diameter from 22 to 30 in.

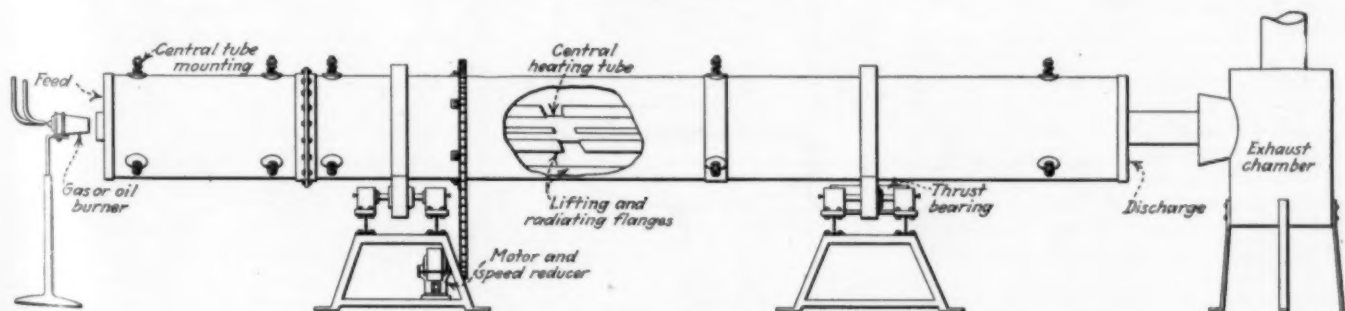
Light-Weight Rotary Drier

A light-weight, portable rotary drier, has recently been developed by Harmor & Company, Walbridge Bldg., Buffalo, N. Y. The drier consists of a cylindrical shell through the center of which runs a heating tube. Flanges are attached to both the inside of the cylindrical shell and the outside of the heating tube, so that material is lifted and cascaded upon the heating tube as the drier rotates.

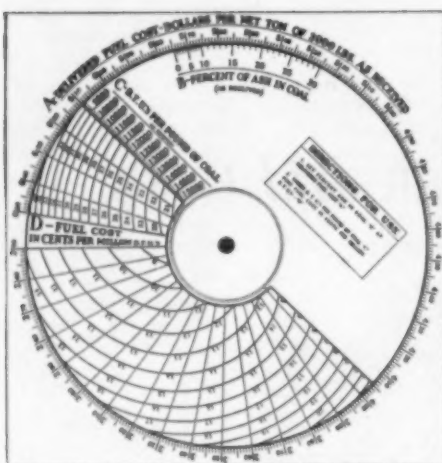
The accompanying cut clearly shows the principal features of the drier. It requires no special foundation and may be mounted upon any floor of a building, or may be moved from place to place as occasion may arise. It may be supplied either as a self-contained unit

Calculator for Coal Heat Unit Cost

A new form of slide rule has been developed by the Coal Specialties Company, 50 Church Street, New York City. It is known as the "Fuel Value Computer" and is arranged to make easy the calculation of the cost of fuel per million available B.t.u., when the delivered cost, ash content and calorific power are known. Based on the best of present-day combustion engineering practice, the scales are so calculated that the fixed charges which must be made against any given coal, due to its ash content, are



Harmor Light-Weight Indirect-Fired Rotary Drier



Calculator for Fuel Cost on the Basis of Available Calorific Power

automatically taken care of in one setting of the scale.

Reference to the illustration will show the construction of the rule. Scale *A* is plotted around a series of curves printed on a sheet of flexible material on which is mounted a semi-circular rider carrying scales for ash and B.t.u. content. In use, the delivered cost per short ton of coal is set on scale *A* against the ash content on scale *B*. Opposite the calorific power on scale *C* may be read the cost per million available B.t.u. By means of the computer the actual cost of different fuels may be quickly obtained. An example of the use of the computer is as follows: A certain coal is delivered at \$5.75 per ton; it contains 5 per cent ash, and the calorific power is 14,000 B.t.u. The illustration shows this particular set-up and it is apparent that the cost per million B.t.u. is 21 cents.

The back of the computer carries tables for conversion of cost on a long ton basis to that on a 2,000 lb. basis. The computer thus contains in itself all that is necessary to make any coal comparison. The data is said to have been so utilized that the results apply equally well for any type of boiler firing.

Carbon Dioxide Purifier

In order to supply an apparatus to remove the taste and odor from carbon dioxide gas resulting as a byproduct in fermentation processes, Sutcliffe, Speakman & Co., Ltd., Leigh, Lancashire, England, have introduced a simple activated carbon scrubber which will serve this purpose.

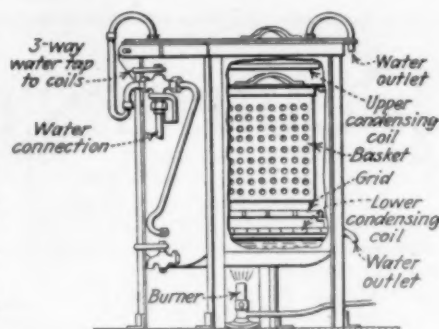
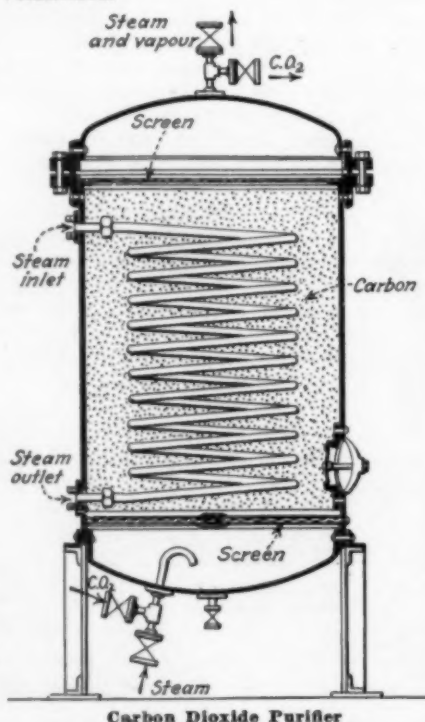
The apparatus is shown in the accompanying illustration. CO_2 is compressed to 250 lb. pressure and passed in at the bottom of the container. The gas is scrubbed through the carbon and leaves from the upper draw-off valve. Regeneration of the carbon at infrequent intervals is accomplished by heating the carbon bed by means of the steam coil shown and by passing steam through the bed. The manufacturer claims that all undesirable taste and odor may be removed with this equipment.

Degreasing Equipment

An interesting adaptation of the reflux condenser principle has been recently applied to a degreasing apparatus known as Crawshaw's Chemical Colander. This device is being marketed by the Castner-Kellner Alkali Company, Ltd., Empire House, Great Charles Street, Birmingham, England.

The colander is shown in the accompanying cut. A non-inflammable, low boiling solvent is placed in the bottom of the tank. This is heated by any simple type of gas burner and volatilized, whereupon the vapors ascend to the top of the apparatus. Here they are condensed by a horizontal cooling coil which is supplied with tap water through the valve shown at the left. The materials to be degreased are placed either in a perforated basket or on a grid shown in the apparatus, and are subjected to the rain of condensed solvent liquor. It is claimed that they are thus cleaned very thoroughly. The solvent material is a product of this company, and is known as Crawshawpol.

When the contents of the colander have been completely degreased, it is simply necessary to reverse the three-way valve controlling the water supply, thus cooling the lower condensing coil. This prevents the volatile solvent from passing above the coil, and enables the operator to keep the solvent at the boil whether or not the apparatus is in use. The manufacturers believe that this device should be of great value to the maintenance departments of industrial plants, and they positively state that degreasing may be carried out more rapidly and at less cost than by any other method. In addition, fire hazard is said to be totally absent. It is claimed that part of the solvent may be recovered for use again and again, and that even when nearly exhausted no grease will be volatilized.



Crawshaw's "Chemical Colander"

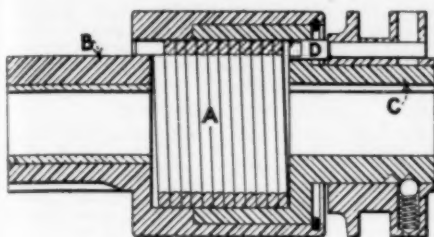
New Surface Pyrometer

The Cambridge Instrument Co., Grand Central Terminal, New York City, is now producing a surface pyrometer in various ranges from 50 deg. F., to 1,200 deg. F. This instrument is a direct reading pyrometer of the thermo-couple type calibrated directly in degrees. It is supplied in a small hand model as well as an extension type used for determining the temperature of inaccessible surfaces. The instrument is intended to measure the temperature of cylindrical surfaces such as the rolls in paper machine driers, textile calenders, or rubber rolls. However, by means of a special adaptor the pyrometer may be easily converted to read the temperature of flat surfaces. Readings, it is said, may be made quickly and without stopping the apparatus under examination. Considerable accuracy is claimed for the device.

Spring Friction Clutch

A spring clutch, for which the manufacturers claim wide application in power transmission equipment, has been introduced by the L. G. S. Manufacturing Company, Indianapolis, Ind. In its simplest form, the clutch consists of a steel coil spring mounted inside of two adjacent and abutting cylindrical bores or pockets. The spring is slightly larger than the bore. When one of the cylindrical members revolves with respect to the other in a direction which would tend to expand the spring, friction between the spring and both cylindrical members builds up very rapidly with a consequent clutching action. If, however, rotation is in the opposite direction, the tendency is to coil the spring, and friction between the spring and the rotating members becomes very slight and the clutch disengages. The mechanism hence acts as a ratchet.

A slight variation of this principle is shown here. *A* represents the spring. *B* and *C* are respectively the two cylindrical members or pockets. *D* represents a sliding pin, moved by means of a collar which engages a yoke on the mechanism. The spring *A* is in this case, slightly smaller than the bore of *B* and *C*. One end of the spring is attached to *B* while the other end engages *D* when the latter is in its extreme left position. This causes immediate expansion of the



L. G. S. Friction Clutch

spring and results in the clutch taking hold. It has been found that the wear on pin *D* is negligible as it is said to serve in a manner comparable to the hand on a locomotive throttle.

Among the applications of the new clutch, one which seems to be of particular interest to the process industries is that where the device is built into a pulley to serve as a centrifugal clutch. A part comparable to pin *D* is actuated by centrifugal force at some predetermined critical speed. By use of the clutch an electric motor driving a piece of equipment may be permitted to attain full speed before the load is put on, thus enabling a motor smaller than would usually be required, to be used. In case of an overload, the clutch automatically disengages, thus protecting the motor. This same device may be used as an unloader for pumps as well as for air compressors.

Portable Conveyor

Through modification and redesign of their portable scraper conveyor, the "Drag-on," the Jeffrey Manufacturing Company, Columbus, Ohio, is now prepared to offer a 25-ft. scraper conveyor which is 1,100 lb. lighter than its predecessors. The decreased weight is gained through lightening of the frame, and shortening the mast. Nevertheless, it is said that the new conveyor is considerably stronger than the older models it replaces.

The wheels are arranged to swivel in either direction so that the conveyor may describe a complete circle around a fixed loading point. Power is supplied by an integrally mounted electric motor. A worm-gearred winch controls the elevation of the discharge end. All parts of the conveyor are equipped for pressure lubrication. The machine is adapted to the handling of coal, coke, and similar materials in power and industrial plants.



Jeffrey "Drag-on" Conveyor

Flush-Type Recorders

The Brown Instrument Company, Philadelphia, Pa., has added a flush type case for the mechanisms of its continuous strip recorders for temperature, CO_2 , and speed. This development now enables this company to supply all of its recording equipment in a type which may be installed flush with the switch-board or panel.

Chilled Iron Idler

The Stearns Conveyor Company, Cleveland, is making a new anti-friction, cast-iron conveyor idler, shown mounted in the adjoining illustration of a 3-pulley carrier. The feature of the new pulley is what is said to be an exceptionally good surface chill. This is unusual in a casting of such small size, and gives the pulley a hard, smooth surface with a tough interior.



Chilled Iron Conveyor Idler

Manufacturers' Latest Publications

The Hayes Corporation, Michigan City, Ind.—Catalog RL 37—describes the improved Hayes CO_2 and draft recorder.

The Niagara Blower Company, Buffalo, N. Y.—A folder describing this company's equipment for producing special apparatus. Albaugh-Dover Manufacturing Company, Chicago, Ill.—Bulletin A—Speed Reducers. Flexitallic Gasket Company, Camden, N. J.—A bulletin describing "Flexitallic" Gaskets.

National Safety Council, 108 East Ohio Street, Chicago, Ill.—This is a new catalog which describes the National Safety Council's new slide and stereopticon service. The catalog includes a complete classified list of the slides on industrial hazards and public safety which are available to members of the council.

Schutte & Koerting Company, Philadelphia, Pa.—Bulletin 17-A—Spur and Herringbone Gear Pumps.

Monitor Controller Company, Baltimore, Md.—Bulletin 111—Monitor Resistors.

Dust Recovery, Inc., 15 Park Row, New York, N. Y.—Bulletin 1—"Dust Problems." Covers the analysis of dust problems, the selection and testing of dust collecting equipment.

The Alsop Engineering Company, 47 West 63d Street, New York, N. Y.—Catalog M-3—"Hy-Speed" Portable Electric Liquid Mixers.

Lee B. Mettler Company, 4406 South Main Street, Los Angeles, Calif.—Folder describing the Mettler Entrained Combustion Gas Burner.

The Bristol Company, Waterbury, Conn.—Catalog 1502—Describes recording wattmeters. Bulletin 363, announces a small size of temperature recorder using a 4-inch chart.

American Blower Corporation, Detroit, Mich.—Bulletin 3504—Type S.E. steel plate blower. Bulletin 51—Series 1, "Siropco" acid resisting fans.

Stacy-Schmidt Manufacturing Company, York, Pa.—Bulletin AS 106, a mailing piece on special machinery.

Bayley Blower Company, 732 Greenbush Street, Milwaukee, Wis.—Catalog 32—complete engineering bulletin on Aerovane Blowers.

International Nickel Company, 67 Wall Street, New York, N. Y.—Bulletin No. 205—"The Practical and Economic Value of Nickel and Chromium in Gray Cast Iron."

Lewis-Shepard Company, 134 Walnut Street, Watertown Station, Boston, Mass.—Folders M.C. 51 describing steel storage racks and No. M.C. 47 on power stackers, lift trucks and platforms for lift trucks.

The Hardinge Company, York, Pa.—Bulletins AH 107 and 112 describing the Hardinge thickener and clarifier and the unit coal pulverizer.

Crouse-Hinds Co., Syracuse, N. Y.—Bulletin 2105—Flood Lighting. Bulletin 2107—Pipe Hangers, Fixture Hangers, Unions and Connectors.

Alexander Milburn Company, Baltimore, Md.—Bulletin B-200-C—Portable Oil Burners and Preheaters. Bulletin B-200-C—Acetylene Generators.

Horace Hills, 533 Market St., San Francisco, Calif.—Folder on the "Simplex" tank filling system.

Electric Machinery Mfg. Company, Minneapolis, Minn.—Bulletin 856—Synchronous Motors for Refrigerant Compressors. Publication 501—List of users of such synchronous motors.

Warner Elevator Mfg. Company, Cincinnati, Ohio.—Bulletin F-18-B—Describes electric dumb waiters.

W. A. Jones Foundry & Machine Company, 4401 West Roosevelt Road, Chicago, Ill.—Catalog No. 35—Complete catalog on worm gear speed reducers.

Pennsylvania Pump and Compressor Company, Easton, Pa.—Bulletin 209—A catalog covering this company's double-suction, single-stage centrifugal pumps.

Cochrane Corporation, Philadelphia, Pa.—Bulletin 675—Publication on domestic deaerators. Discusses corrosion by dissolved oxygen and its prevention.

The Duraloy Co., Pittsburgh, Pa.—Bulletin No. 276, General Information on Duraloy; Bulletin No. 277, Stainless Duraloy; Bulletin 279, Duraloy in the Mining Industry.

Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.—Folder on proportioning pumps for pressure and lime oil service.

Linde Air Products Co., 30 E. 42nd St., New York, N. Y.—Pamphlet on "Welded Piping."

Morse Chain Co., Ithaca, N. Y.—New handbook on silent chain drives.

La Motte Chemical Products Co., Baltimore, Md.—"The ABC of Hydrogen Ion Control." Concerns the colorimetric determination of hydrogen ion concentration.

Celite Products Co., Los Angeles, Calif.—"Sil-O-Cel Insulation"—A complete and well illustrated handbook on the fundamentals of insulation, the design of insulated equipment, and the application of insulation to equipment in numerous specific industries. Also Bulletin 336 on the effect on concrete workability of the addition of Celite.

The Ludlow-Saylor Wire Co., St. Louis, Mo.—Catalog No. 48—"Getting Results with Ludlow-Saylor Screens." A bound volume containing much data on the use and selection of woven screens, and their application in many specific industries. Engineering data is also included.

Sturtevant Mill Co., Harrison Square, Boston, Mass.—Leaflet on vibrating screens.

General Electric Co., Schenectady, N. Y.—publications as follows: GEA-505A, Outdoor Station Equipment; GEA-712A, type BTA Motors; GEA-856, Outdoor Station Equipment; GEA-857, Outdoor Station Equipment; GEA-887, Drum Controllers; GEA-890, Railroad Turntables; GEA-905, Insulated Wires and Cables; GEA-915, Primary Cutout and Disconnecting Switch; GEA-918, Improved Brush Holders; GEA-920, Field Coils; GEA-923, Insulated Cables; GEA-925, Oil Circuit Breakers; GEA-928, Starting Switches; GEA-929, Switches with Laminated Studs; GEA-930, Electric Furnaces for Lead Hardening; GEA-933, Journal Box Linings.

Semet-Solvay Engineering Corp., 40 Rector St., New York, N. Y.—Pamphlets as follows: No. 333, Van Stone Joints; No. 334, Steere Cooling Coils.

National Electrical Mfrs. Assn., 420 Lexington Ave., New York, N. Y.—A discussion of the National Electrical Code.

H. W. Caldwell & Sons Co., Western Ave. at 17th St., Chicago, Ill.—Book No. 959—A catalog covering screw conveyors.

American Manganese Bronze Co., Phila., Pa.—Bulletin H-1—A series of sheets covering the development, physical characteristics and uses of Hy-Ten-SI bronze.

The International Nickel Co., 67 Wall St., New York, N. Y.—Buyers' Guide for Monel and Pure Nickel Products.

Rollway Bearings Co., Syracuse, N. Y.—Catalog 4-A—Rollway Cylindrical Roller Bearings. Covers the wide series and utility types.

PATENTS ISSUED

Jan. 31 to Feb. 28, 1928

PAPER, PULP AND SUGAR

Process for the Production of Cellulose by Decomposition of Vegetable Fibers. Otto C. Strecker, Darmstadt, Germany.—1,658,213.

Pulp Digester. Adolph W. Waern, Ontonagon, Mich.—1,658,216.

Process for Freeing Cellulose Fibers from Vegetable Materials. William I. Chidester, Portland, Ore.—1,659,809.

Paper-Manufacturing Machine. John W. Brassington, Port Arthur, Ontario, Canada, assignor to The Paper and Textile Machinery Company, Sandusky, Ohio.—1,660,643.

RUBBER, RAYON AND PLASTICS

Process for Vulcanizing Rubber and Products Obtained Thereby. Morris L. Weiss, Newark, N. J., assignor to Dovan Chemical Corporation, New York, N. Y.—1,657,522.

Manufacture of Artificial Silk. Friedrich Wilhelm Schubert, Apperley Bridge, near Bradford, England, assignor to Brysilka, Limited, Apperley Bridge, near Bradford, England.—1,657,697.

Resin and Method of Preparing the Same. Reinhard Beutner, Louisville, Ky., assignor to Aug. Nowack Aktiengesellschaft, Bautzen, Germany.—1,658,281.

Process for Reducing the Viscosity Characteristics of Cellulose Acetate. Leonard E. Branchen and Chauncey U. Prachel, Rochester, N. Y., assignors to Eastman Kodak Company, Rochester, N. Y.—1,658,368.

Cellulose-Ether Composition. Stewart J. Carroll, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y.—1,658,369.

Cellulose Solution and Process for Making Same. Leon Lillienfeld, Vienna, Austria.—1,658,606.

Process for the Manufacture of Articles of Plastic Material. Alfred Landucci, Paris, France, assignor, by mesne assignments, to Du Pont-Pathe Film Manufacturing Corporation, Wilmington, Del.—1,658,725.

Resinous Bodies Produced from Formaldehyde and Colophony and Method of Producing Same. August Amann, Wiesbaden, Germany, assignor, by mesne assignments, to Chemische Fabriken Dr. Kurt Albert G. m. b. H., Bleibach-on-the-Rhine, Amöneburg, Germany.—1,658,828.

Manufacture of Viscose. James M. Leaver, Oakland, Calif., assignor to The Pacific Lumber Company, San Francisco, Calif.—1,659,033.

Apparatus for Distilling Crude Resins. Georges Honore Dupont, Gironde, France.—1,659,727.

Process for the Preparation of a New Type of Shellac Substitutes. Johannes Scheiber and Walther Noack, Leipzig, Germany.—1,660,094.

Process for the Continuous Preparation of Phenolic Resins. Victor H. Turkington, Evanston, Ill., assignor to Bakelite Corporation, New York, N. Y.—1,660,403.

COMBUSTION AND FURNACES

By-Product Coke Oven and Method of Operating Same. Joseph Van Kirk Borland.—1,658,796.

Flocculated Fuel Compound. John Jay Tonkin, Somerville, N. J.—1,659,337.

Gas Producer. Charles W. Lumma, Worcester, Mass., assignor to Morgan Construction Company, Worcester, Mass.—1,659,493.

Apparatus and Process for Burning Fuel. Edgar W. Clarke, Evanston, Ill., assignor to American Tar Products Company, Chicago, Ill.—1,660,331.

PETROLEUM REFINING

Process and Apparatus for Treating Hydrocarbon Oils. Hiram W. Camp, Tulsa, Okla., assignor to Doherty Research Company, New York, N. Y.—1,657,524.

Method of Distilling Hydrocarbons and Fuel Produced Thereby. Lindell T. Bates, Mount Lebanon, N. Y.—1,657,815.

Process of Cracking Oils. John Collins Clancy, New York, N. Y.—1,658,116.

Refining Petroleum Oils. Paul McMichael, Flushing, N. Y., assignor to Hydrocarbon Refining Process Co. Inc., New York, N. Y.—1,658,171.

Purification of Benzol, Petrol, and the Like. Kenneth Cox and Percival John McDermott, Manchester, England, assignors to Refiners Limited, Manchester, England.—1,658,285.

Treatment of Natural-Gas Gasoline. Casinghead Gasoline, Natural Gasoline, and the Like. Harold B. Bernard, Tulsa, Okla., assignor to Sinclair Oil and Gas Company, Tulsa, Okla.—1,658,322.

Process for Cracking Petroleum Oil. Robert T. Pollock, Boston, Mass., assignor to Universal Oil Products Company, Chicago, Ill.—1,658,415.

Removal of Sulphur and Sulphur Compounds from Hydrocarbon Oil. Gerald L. Wendt, Chicago, Ill., assignor to Standard Oil Company, Whiting, Ind.—1,658,505.

Purification of Petroleum Oils for Removal of Sulphonated Compounds. Robert C. Moran, Woodbury, N. J., assignor to Vacuum Oil Company, New York, N. Y.—1,659,752.

Process for Breaking Petroleum Emulsions. Melvin De Groote, St. Louis, Wilbur C. Adams, University City, Mo., Edward H. Keiser, Clayton, Mo., and Claudius H. M. Roberts, El Dorado, Ark., variously, assignors to Wm. S. Barnickel & Company, Webster Groves, Mo.—1,659,993-1,660,005.

Oil Composition and Process of Preparing the Same.—Ralph T. Goodwin, Elizabeth, N. J., assignor to Standard Oil Development Company.—1,660,294.

Treatment of Hydrocarbon Residues and Product Obtained Thereby. Ralph T. Goodwin, Elizabeth, N. J., assignor to Standard Oil Development Company.—1,660,295.

ORGANIC PROCESSES

Manufacture of Dinitrotoluene. Ernest Harry Rodd and Reginald William Everatt, Blackley, Manchester, England, assignors to British Dyestuffs Corporation Limited, Manchester, Lancashire, England.—1,657,723.

Process of Producing Indigo White. Julius E. Seitz, Penns Grove, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,657,869.

Catalytic Alkylation of Aromatic Hydrocarbons. Morris G. Shepard, New York, N. Y., assignor to The Naugatuck Chemical Company, Naugatuck, Conn.—1,658,176.

Benzyl Resorcinols. Alfred R. L. Dohme, Baltimore, Md., assignor to Sharp & Dohme, Inc., Baltimore, Md.—1,658,229.

Process for the Fusion of Aromatic Sulphonic Compounds. Charles Raymond Downs, New Haven, Conn., assignor to Weiss and Downs, Inc., New York, N. Y.—1,658,230.

Condensation Products Obtained from Urea and Solid Polymers of Formaldehyde and Process of Making Such Products. Friedrich Ernst Karl Steppes, Harburg-on-the-Elbe, Germany, assignor to Dr. Heinrich Traun & Söhne, Hamburg, Germany.—1,658,359.

Process of Making Lead Alkyls. Merrill Arthur Youtz, Chicago, Ill., assignor, by mesne assignments, to General Motors Corporation, Detroit, Mich.—1,658,544.

Condensation Product and Method of Making Same. Palmer W. Griffith, Elizabeth, N. J., assignor to American Cyanamid Company, New York, N. Y.—1,658,597.

Apparatus for the Production of Carbon Black. William Farrell Fulton, Shreveport, La., assignor to Palmer Corporation.—1,658,676.

Gelatin Dynamite. Carl D. Pratt, Tamaqua, Pa., assignor to Atlas Powder Company, Wilmington, Del.—1,658,816.

Dye Powder and Process of Manufacture. Oakley M. Bishop, Wilmington, Del., and Merville S. Thompson, Penns Grove, N. J., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,659,131.

Manufacture of Pure Urea. Leopold Bub, Mannheim, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt-on-the-Main, Germany.—1,659,190.

Nitrocellulose Composition. Charles Bogin, Terre Haute, Ind., assignor to Commercial Solvents Corporation, Terre Haute, Ind.—1,659,906.

Process of Dehydration of Alcohol for Carburants. Elol Ricard and Henri Guinot, Melle, France, assignors to Société Ricard, Allenet & Cie., Distilleries des Deux-Sevres, Melle, Deux-Sevres, France.—1,659,958.

Process of Obtaining High-Grade Prod-

ucts from Raw Coal. Fritz Ludwig Kühlwein, Billwärd, Hamburg, assignor to the Firm Chemische Fabrik in Billwärd vorm. Hell & Sthamer A. G., Hamburg-Billbrook, Germany.—1,660,009.

INORGANIC PROCESSES

Process of Burning or Subliming Sulphur. Henry F. Merriam, West Orange, N. J., assignor to General Chemical Company, New York, N. Y.—1,657,545.

Process for the Production of Salts from Brines and Solutions. Otto V. Martin, Sand Springs, Okla., assignor to The Martin-Colvin Co.—1,657,633.

Process of Modifying Glauconite. Arthur C. Spencer, Washington, D. C., assignor to The Permutit Company, New York, N. Y.—1,657,700.

Corrosion-Resistant Alloys. Michael G. Corson, Jackson Heights, N. Y., assignor to Electro Metallurgical Company.—1,657,957.

Protective Colloid and Process of Preparing the Same. Fritz Heildberg, Philadelphia, Pa.—1,658,289.

Apparatus for Treating Aluminous Materials. Edel Moldenke, Harrisonburg, Va., assignor to Moldenke Process Corporation, Watchung, N. J.—1,658,457.

Fluorescent Paint. Leroy J. Buttolph, Grantwood, N. J., assignor to Cooper Hewitt Electric Company, Hoboken, N. J.—1,658,476.

Process of Obtaining Argon. Walter Dannenbaum, Frankford, Pa., assignor to Pacific Nitrogen Corporation, Philadelphia, Pa.—1,658,631.

Process of Making Zirconium Compounds. Charles J. Kinzie, Niagara Falls, N. Y., assignor to The Titanium Alloy Manufacturing Company, New York, N. Y.—1,658,807.

Process of Making Substantially Pure Hydrogen. Charles E. Parsons, New York, N. Y., assignor to Metal Research Corporation, New York, N. Y.—1,658,939.

Manufacture of Ammonium Phosphate. Robert Griessbach, Ludwigshafen-on-the-Rhine, and Kurt Röhre, Mannheim, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt-on-the-Main, Germany.—1,659,198.

Process of Making Hydrogen Peroxide. Hugh S. Taylor, Princeton, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,659,382.

Method of Separating Cyanides from Mixtures. Guy H. Buchanan, Westfield, N. J., assignor to American Cyanamid Company, New York, N. Y.—1,660,667.

CHEMICAL ENGINEERING EQUIPMENT AND PROCESSES

Heat-Insulating Material and the Process of Its Manufacture. William W. Odell, Minneapolis, Minn.—1,657,582.

Construction Material. Ray P. Perry, Upper Montclair, N. J., assignor to The Barrett Company.—1,657,585.

Recuperator. Ernest W. Wescott, Niagara Falls, N. Y., assignor to Comstock & Wescott, Incorporated, Boston, Mass.—1,657,704.

Process of Desiccation. Walter H. Dickerson, East Orange, N. J., assignor to Industrial Waste Products Corporation, Dover, Del.—1,658,078.

Furnace of the Recuperative Type. James Loewy Hott, Canton, Ohio.—1,658,199.

Pumping Apparatus. Frederick Trouton Small, Spondon, near Derby, England, assignor to Celanese Corporation of America.—1,658,307.

Method of Making Refractory Products and Articles Produced Thereby. William A. Farish, Buffalo, N. Y., assignor to Buffalo Refractory Corporation, Buffalo, N. Y.—1,658,406.

Cement-Kiln System. David S. Jacobus, Jersey City, N. J., assignor to The Babcock & Wilcox Company, Bayonne, N. J.—1,658,443.

Fluid-Level Indicator for High-Pressure Vessels or Containers. Stephen Löffler, Berlin—Charlottenburg, Germany.—1,658,449.

Rotary Agitator. Edgar B. Nichols, Rochester, N. Y., assignor to The Pfaunder Co., Rochester, N. Y.—1,658,460.

Valve. Joseph Machtoff, Celle, Germany, assignor to the Firm Chr. Hostmann-Steinberg'sche Farbenfabriken G. m. b. H., Celle, Germany.—1,658,810.

Refinery Power Plant. Milton J. Trumble, Alhambra, Calif.—1,658,910.

Grinding Mill. Russell Shephard, Cleveland, Ohio.—1,659,668.

Liquid Separator. Edwin Comer Smith, Baltimore, Md.—1,660,140.

Electric Furnace. Edward C. Sasnett, Washington, D. C., assignor, by mesne assignments, to Chas. B. Foley, Inc.—1,660,209.

Mixing and Crushing Machine. Chandos Roy Dimm, Muncy, Pa., assignor to Robinson Manufacturing Company, Muncy, Pa.—1,660,221.

Air-Blast Classifier. Albert H. Stebbins, Los Angeles, Calif.—1,660,682-7.

NEWS of the Industry

Dr. Davis Selected To Head Stevens Institute

IT WAS announced on March 8 that Dr. Harvey Nathaniel Davis, now occupying a chair of mechanical engineering at Harvard University, Cambridge, Mass., has been selected as president of Stevens Institute of Technology at Hoboken, N. J., to succeed the late Dr. Alexander C. Humphreys who resigned last June upon the completion of 25 years of service. Dr. Davis will assume his new duties on September 1 next.

Dr. Davis has been professor of mechanical engineering at Harvard since 1919 and previously served as instructor and assistant professor in physics there. His professional activities, outside of the educational field, include engineer in the turbine department of the General Electric Company, aeronautical mechanical engineer in the United States Air Service, consulting engineer in the U. S. Bureau of Mines and in the Franklin Railway Supply Company and the Air Reduction Company.

Dr. Davis was born in Providence, R. I., June 6, 1881. He was graduated with distinction at Brown University, from which he received the degrees of A.B. and A.M. He then entered Harvard University, his work there leading to the degrees of A.M. and Ph.D. Subsequently he joined the Harvard faculty.

Cottonseed Investigation Finds No Manipulation

EVIDENCE of cottonseed price manipulation on the part of crushers and refiners in violation of the anti-trust laws or the Federal Trade Commission Act is not apparent, the Federal Trade Commission announced March 4, in describing a report to be submitted to Congress on its investigation into alleged irregularities in the cottonseed industry.

The inquiry is the result of a resolution adopted in the House last March declaring prices paid by cottonseed interests to cottonseed producers had been uniform for several years and it therefore appeared that the cottonseed interests were in "agreement or combination on the prices to be paid the producers," and this was said to be "in restraint of trade."

Round Table Discussions at A.C.S. Meeting

The spring meeting of the American Chemical Society which will be held at the Chase Hotel, St. Louis, April 16-20, will be featured by round table discussions. One of these on "Chemical Engineering Equipment" will be led by Prof. W. T. Read, Texas Technological College and one on "Filtration" will be in charge of D. R. Sperry, D. R. Sperry & Company. R. E. Wilson, Standard Oil Company, Whiting, Ind., will lead the discussion on the subject of "Lubrication."

Nichols Medal Conferred on Hugh S. Taylor

PROF. HUGH STOTT TAYLOR was the recipient on March 9 of the Nichols Medal for 1928 at a joint meeting of the New York section of the American Chemical Society, the American Electrochemical Society, the Society of Chemical Industry and the Société de Chimie Industrielle, following a dinner at the Chemists' Club.

Before a capacity audience Dean James Kendall of New York University made the initial address, "Now It Can Be Told," in which he depicted the personality of his former colleague under Arrhenius with anecdotes tracing to their long personal connection.

The next speaker, Prof. Wilder D. Bancroft of Cornell, reviewed the medalists' work on catalysis, for which the award was made, in a critical and appreciative way.

The actual presentation was made by Prof. Arthur W. Thomas of Columbia, in the absence of Dr. William B. Nichols, the donor of the medal. In his speech of acceptance Professor Taylor acknowledged his personal indebtedness to three stimulating factors in his researches: Princeton University, his colleagues and graduate students, and his contact with industry. The latter, he emphasized, could be of invaluable aid in the progress of research, reminding his audience of the contact process for sulphuric acid and the effect of the first synthetic methanol shipment to America. The discourse in its entirety represented an illuminating aspect of the present stand of chemical catalysis.

Naval Stores Trade Plans Advertising Campaign

NEARLY 300 technical and commercial men participated in the fifth annual Naval Stores Conference which was held February 20-22 at Savannah, Georgia. This conference, under the general chairmanship of Thomas J. Aycock, was participated in by a record size group and much more than the usual interest developed. One of the outstanding decisions reached by the participants was to initiate a national turpentine advertising campaign for which it is hoped to have available \$80,000 per year for a period of three years.

The service of research to the naval stores industry was emphasized by a number of the speakers, including particularly those directing the research at Mellon Institute under a fellowship arrangement with the Pine Institute of America. Other speakers on the technical and research opportunities before the industry included Wm. J. Hale, C. H. Herty, Eloise Gerry, J. O. Read, and F. P. Veitch. Foreign sales opportunities were discussed by papers from C. C. Concannon, S. J. Reagan, and W. T. Daugherty, all of the Bureau of Foreign and Domestic Commerce.

The packaging of rosin and the net weight basis of sale were the subject of a progress report by the committee of the conference which includes producers, distributors, and users. Definite progress seems to be resulting from the meeting of the various interests whose ideas have been in conflict on the proper packaging and billing procedure. A considerable number of producers and distributors are now offering rosin on the basis of net weight quotations, which is the basis desired by a substantial percentage of rosin users. Some progress is also being made toward the packaging of rosin in metal containers and in more substantial wooden barrels, as wanted by some users. Apparently, however, typical practice still continues on the basis of a rather unsatisfactory wooden barrel and billing upon the basis of gross weight.

It was enthusiastically voted to hold another conference at Pensacola in 1929. This will be under the general chairmanship of Q. H. L. Wernicke, with C. F. Speh continuing as general secretary.

James H. McGraw Receives Bok Medal for Elevating Advertising Standards

Publisher of *Chem. & Met.* Honored for Work in Developing the Business Press

IN RECOGNITION of "his lifelong service in the upbuilding of higher standards in advertising in the business press of the country" the jury of the 1927 Harvard Advertising Awards has presented to James H. McGraw the Gold Medal for Distinguished Contemporary Services to Advertising. This is the highest of ten awards founded in 1923 by Edward W. Bok. They are administered by the Graduate School of Business Administration of Harvard University and are offered in the conviction that advertising, wisely utilized, is a great economic power to broaden markets and decrease the cost of distributing goods; but if unscientifically employed is wasteful to the community.

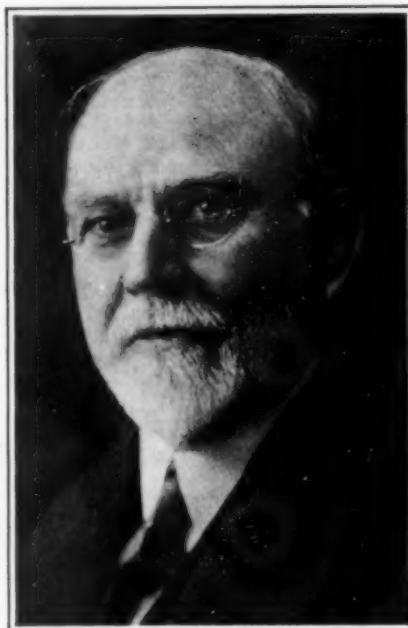
Presentation of the gold medal was made at a dinner at the Faculty Club, Boston, on Feb. 17, with O. M. W. Sprague, acting dean of the School, in charge. Professor Sprague touched on Mr. McGraw's pioneering work in the recognition of advertising's relation to marketing, and of his constructive service in the upbuilding of the highest advertising practices among the organized business press. The medal bears the inscription: "To James H. McGraw—For distinguished personal service rendered American commerce and industry through raising the standard of advertising—1927."

BECAUSE of illness Mr. McGraw was unable to be present at the award and the medal was accepted in his behalf by Malcolm Muir, vice-president of the McGraw-Hill Publishing Company. Mr. Muir presented an address which had been prepared by Mr. McGraw and which in part follows:

"The very planning of advertising results in a most searching examination of profits since the distinctive elements must be determined. If, perchance, there be no market distinction, then, at the very least, advertising may guarantee a continuance of quality. The market for position of certain brands of flour, bread, soap, cement, brass, industrial belting—the prosperity attending their makers—is eloquent testimony of advertising's effectiveness in the staple field.

"True, advertising does not confer full immunity from price considerations and consequent narrow profits and halting markets, but it does shift the competition to bases of quality and use. It puts the battle on the seller's rather than on the buyer's ground, but at the same time it proves a boon to the buyer because of insistence on quality. 'Quality is remembered long after price is forgotten' is a slogan already accepted as a principle by industrial consumers. It suggests distinct social advantages to consumers at large.

"Advertising cannot create qualities. Advertising cannot give market standing to a product where market value does not exist. It is sheer folly to assume that a product will take on compelling qualities if only they be claimed in advertising. Advertising can express, develop and amplify what is already present. It can stimulate the seed of



JAMES H. MCGRAW

product or service personality to growth and vigor. It cannot create the seed.

"How often, through widespread advertising, do we learn that some worthy product, unknown because unheralded, is now to step out and claim its rightful place in the market. Advertising, presumably, is to supply the vitality, lacking for long slumbering years; advertising, presumably, is to create overnight the effective producing organization that the years should have been developing; advertising, presumably, is to create marketing courage where timidity has calmly reigned. Invariably the effort fails. The newcomer, flashing meteor-like across the sky, fades quickly and leaves but black night.

"If advertising is to be an effective instrument of prosperity, soundness of marketing methods must be added to soundness of product or service. Distribution costs are being subpoenaed to appear before the court of public opinion. Too often advertising has had to bear the unjust odium of marketing's shortcomings. The logical markets may have been wrongly appraised. Distribution was attempted under conditions that made the cost prohibitive.

Effective advertising must be reared

on two sturdy foundations; the first, a product or service which meets existent or unexpressed needs of the market; the second, a waste-free marketing plan for reaching responsible buyers."

In addition to being president of the McGraw-Hill Publishing Company, Mr. McGraw is chairman of the McGraw-Shaw Company, and chairman of the McGraw-Hill Book Company.

Varied Program for Spring Meeting of A.E.S.

PLANS are rapidly nearing completion for the spring meeting of the American Electrochemical Society which will be held at the Hotel Stratfield, Bridgeport, Conn., April 26-28.

Dr. George W. Vinal, of the Bureau of Standards, will be in charge of the first session, the symposium subject being "Chemical Production of Electricity." Other participants in this discussion on electrolytic rectifiers, storage batteries, gas cells, dry cells and standard cells will be Marion Eppley, George E. Stringfellow, M. L. Martus and C. A. Gillingham. Papers received for publication to date on these subjects are as follows: "The Mercurous Sulfate Electrode for Testing Storage Batteries," by S. Makio; "Notes on Graphitic Oxide and the Brodie Reaction," by Oliver W. Storey; "Electrochemical Production of Graphitic Oxide," by Bruce K. Brown and Oliver W. Storey; "Graphitic Oxide as a Depolarizer in the LeClanche Cell," by Bruce K. Brown; "Gelatinization of Corn Starch in Dry Cell Electrolyte," by W. D. Staley and A. J. Helfrecht; "Rapid Dry Cell Testing," by J. G. Zimmerman; and "The Potentials of Manganese Dioxide in Electrolytes of Various Hydrogen-ion Concentrations," by T. J. Martin and A. J. Helfrecht.

On the afternoon of April 27 the members and guests will have an opportunity to visit brass and other industrial plants in Bridgeport and vicinity. The evening will be devoted to an illustrated lecture on the "Refraction of X-rays in Elements and Compounds," by Prof. Bergen Davis, of Columbia University.

The session on Friday morning, April 27, will be devoted to a discussion on industrial electric heating, held jointly with the National Electric Light Association. Participants in this discussion will be R. M. Keeney, John L. Christie, R. E. Talley and others. A new film on "Electric Heat in Industry," showing the uses of electric heat in large industrial plants, will also be presented. Immediately following this session Dr. B. D. Saklatwalla, chairman of the Electrothermic Division, will preside at the informal Round Table Discussion.

The morning session on April 28, in charge of Prof. E. M. Baker, chairman of the Electrodeposition Division, will be devoted to problems dealing with the plating of silver, nickel, brass and chromium. Eight papers will be presented.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

AS THIS is written, the debate on Muscle Shoals in the Senate appears to be converging to a close. The Senate has spent much more time in the consideration of the Norris resolution than had been expected. The body is divided into three camps. Senator Norris and his followers want a bill containing a government operation feature which is objectionable to a second group that is willing to follow the Norris plan, if that feature is eliminated, and provision made for the distribution of power under state regulation without discrimination among states and municipalities. When the debate was at its height the following letter from the Secretary of Agriculture was brought forward. In its essential parts it reads: "I am in favor of those provisions of the Norris resolution which provide that the power and fertilizer phases of the Muscle Shoals project shall be handled separately and that the income from the power be dedicated to agriculture and used to introduce improved fertilizers and better fertilizer practice. I am convinced that this is sound policy and should be adhered to. Under the authorization granted the Secretary of Agriculture, this department will be able to use the income from the power facilities in a way to give agriculture the maximum benefit. The provisions of the resolution covering the fertilizer program have the flexibility which is necessary if efficient work is to be done in this field, where changes come so rapidly.

"The advisability of directing at this time the completion of the machinery installation at Dam No. 2 and the steam plant at nitrate plant No. 2 is questioned. Decision on this point would, of course, largely depend on the policy adopted in disposing of the power problem. Since it is the policy of the administration to dispose of the property, if possible, it may be pointed out that authorization is lacking in the bill to allow lease of the hydro-electric facilities and lease or sale, in whole or in part, of the nitrate plants, including the steam units, which alternatives the administrative agency finally intrusted with the property should have."

THE views of the third camp are well expressed by the American Farm Bureau Federation which issued the following statement on March 8: "For ten long years American farmers have been promised cheaper fertilizers through the utilization of Muscle Shoals. Each year we have had to oppose the power trust that wants to keep Muscle Shoals power in its grasp. Each year some members of congress have endeavored to offer us some sort of theory

or experiment instead of the actual nitrogen for fertilizers which can be produced at Muscle Shoals.

"Now that we have a definite offer from a company actually in the business of making this kind of concentrated fertilizer, naturally we do not look with favor upon the Norris resolution which promises us only more experimentation. We believe with Senator Black that the adoption of the Norris resolution would not only fail to give the farmer fertilizer but would also fail to give cheap electricity, since the Alabama Power Company will by one means or another gain control of the distribution of this power to the consumer.

"All argument about the cyanamid process being obsolete has fallen of its own weight. No evidence has been produced in the Senate to show that the synthetic process produces nitrogen for fertilizer purposes cheaper than does the cyanamid process under American conditions. The cold hard fact remains that not a single pound of air fixed nitrogen has been produced in America for fertilizer purposes by the synthetic process, while thousands of tons are being produced by the cyanamid process and—what is fully as convincing—meeting foreign synthetic process competition in the open markets of the world. The truth of the matter is that with the many technical improvements introduced in the past few years the cyanamid process is today just as "new" as the synthetic process.

The situation in regard to Muscle Shoals in the House is badly muddled. At this writing hearings are in progress on the Morin bill, which recommends the separation of the power and fertilizer operations and provides for the distribution of power by lease in much the way recommended by the Secretary of Agriculture.

W. C. MARTIN, a chemist from the technical division of the Prohibition Bureau has recently completed a three weeks' trip through the east and mid-west during which time he made a survey of the industrial alcohol needs of the leather and artificial leather concerns in these sections. Mr. Martin devoted particular attention to a study of the best types of industrial alcohol for the needs of the leather industry. At present the types of industrial alcohol used for this purpose is classified by the Prohibition Department as: S.D.A. 2-B; 12-A; 23-A; S.D.A. No. 1; and completely denatured alcohol numbers one and five.

Dr. Linter, Chemist of the Prohibition Bureau stated that this canvassing of industry is part of a definite program, the general object of which is to obtain

data on the usage of industrial alcohol for various purposes. He pointed out, however, that this research work is being done with no thought of preying upon industry but rather with the idea of co-operating in all problems pertaining to alcohol.

IMPORTS of dyes of high monetary value have reached such proportions and are increasing so rapidly as to attract the particular attention of those who are working for the upbuilding of the American chemical industry. The attention of American dye manufacturers is to be called to what is regarded as a very fertile field in which they can operate. With a few notable exceptions, it is pointed out, American manufacturers have confined themselves largely to the production of tonnage dyes. It is declared that there is no technical or other reason why most of the dyes now being imported so heavily should not be made in this country. The same situation prevails, it also is declared, with regard to synthetic aromatic products.

Two fine materials, such as turpentine and rosin, which are capable of being broken down into valuable byproducts, should be devoted to higher uses than thinning paint and as a filler for soap. This was one of the keynotes sounded at the naval stores "Get Together" at Savannah, February 20, 21 and 22. Government chemists who attended the meeting report that the plea for more chemical research in the naval stores industry fell on receptive ears.

There seems to be a general determination in the industry to encourage research. It is recognized that their products are going into elemental uses for which substitutes are available.

The action of the meeting in voting a large sum for national advertising met the approval of the chemists as they realize that production must be marketed for present uses for many years. This must be done at a profit large enough to allow a margin for research. While the launching of group research will have to go over for at least a year, a number of individual companies are strengthening their research departments. Apparently most of the producers recognize that their industry offers a particularly fertile field for chemical research and are anxious to get such work under way at the earliest possible time.

The Federal Trade Commission is making its final arrangements for its hearings in the investigation of the electric and gas industries. It is stated at the offices of the commission that the utilities are co-operating in every way to make the investigation thoroughly efficient. So as to secure certain fundamental data which will aid in the conduct of the hearings, it is understood that the commission is about to send out a carefully prepared questionnaire to the industry.

All the subpoenas now have been issued to take care of the initial hearings.

Interesting Developments in British Rayon Industry

Stock Dividend Planned By Courtaulds—New Company To Produce Acetate Silk

From Our London Correspondent

THE RAYON industry continues to attract public attention and the new company referred to in these notes last month for the production of acetate silk has been successfully formed with a capital of \$5,000,000. The directorate of the Cellulose Acetate Silk Company as it is called, is particularly strong, and it is understood that their scientific adviser, Dr. Levinstein and also Sir Herbert Blain of the Non-Inflammable Film Company will join the board. The principal patent is No. 258,820 in the name of H. J. Mallabar, and is based on the discovery that improved results can be obtained when the known method of acetylation is modified by first treating the cellulose in the cold with an excess of acetic acid containing a small proportion of sulphuric acid, neutralising the latter by sodium acetate and finally acetylating the neutral solution with acetic anhydride at 30 deg. to 40 deg. Centigrade in the presence of a limited quantity of zinc chloride. This avoids the defects due to acetylation in the presence of strong sulphuric acid and in addition the company has available the manufacturing patents of W. P. Dreaper who has been working for many years in the rayon field.

The formation of this company has enabled the Non-Inflammable Film Company to dispose of the factory they had purchased at Lancaster and which will be used for the manufacture of this new acetate rayon. It seems unlikely that the Celanese concern will take any active steps in regard to patent rights until actual manufacture is closer at hand. It is proposed to commence with an output of 8 tons per day of which 4 tons will be reserved for the use of the Non-Inflammable Film Company for the next 10 years. The factory is subsequently to be increased to a capacity of 12 tons per day.

In the viscose field, considerable excitement was caused on the Stock Exchange by the dividend announcement of Courtaulds Limited on the basis of nearly \$25,000,000 of profit during the past trading year. Moreover, the reserves are to be capitalized and a share for share bonus paid to the shareholders, mainly on account of the revaluation of the shares in the American Viscose Company. As a result, Courtaulds shares have gone up by about 25 per cent.

RUMORS are still current in regard to possible new acquisitions by I.C.I., and the view is expressed that these may take the form of further amalgamations in the dyestuff industry, firms such as the British Alizarine Company and Messrs. Hickson & Partners having been mentioned in this con-

nection. The only tangible result so far has been an offer to purchase the salt business of the Tees Salt Company, which adjoins the works of Synthetic Ammonia & Nitrates Limited, and this together with the installation of additional units for the latter firm's power station, may foreshadow the addition of an electrolytic alkali plant to these works.

As regards the I.C.I. labor policy, it was only to be expected that the National Labor Executive should endeavour to make capital out of such a well meant scheme and attempts are now being made to alienate the chemical workers under pressure from the national executive council. It is alleged that the real objectives of the I.C.I. labour policy are to eliminate all forms of trade unionism in the works and to isolate the combine workers from the general body of British labor. It is even suggested that the I.C.I.'s policy of rationalisation may result in excessive speeding up of production and distribution and ultimately in the reduction of employment and an attack upon the basic wage standard. It is most unlikely that this "démarche" will have any material effect upon the situation.

AT PRESENT writing the British Industries Fair is in full swing in London and in Birmingham, the chemical section being at the White City, London. The excellence of the chemical section during the last three years has been largely due to the work of W. J. U. Woolcock, general manager of the Association of British Chemical Manufacturers, but this year will probably be his last in that particular field, as it is understood, he will shortly join the executive staff of the Mond Staffordshire Refining Company. This concern has recently placed on the market a new disinfectant called "monsol," a coal-tar product of high germicidal strength, stated to be without harmful action upon tissues and largely advertised as an ingredient in throat pastilles and other medicinal and disinfectant preparations. It can hardly be said that the chemical exhibits are worthy of the British Chemical Industries as regards their scope and extent, but individual firms are certainly to be congratulated upon having done their duty. Fine chemicals, lacquer ingredients and medicinal products are given greater prominence than usual. Considerable interest is being taken in the work of British Drug Houses Limited. One of its latest products is "radiostol" which is, to all intents, vitamin D. The product is said to contain two hundred thousand times as much of vitamin D as the best cod-liver oil, and consists essen-

tially or irradiated ergosterol, is tasteless and available for use either as pellets or in the form of radio-malt, a product with a flavor of toffee and the consistency of honey. It is anticipated that such preparations apart from their medicinal application will be increasingly used for margarine and other food products deficient in vitamins.

THE slogan "Ethyl has come" has at last reached this country and automobile owners are now eagerly considering whether the alleged dangers of tetra-ethyl lead have sufficient foundation to warrant due caution in switching over to the new fuel. Exhaustive tests are being carried out under the auspices of a daily newspaper, but it seems probable that in spite of a vigorous advertising campaign ethyl petrol will only gradually find favor. Moreover, in a letter to the *Times*, Sir William Pope draws attention to the negative nature of the United States Public Health Service report and expresses surprise that lead tetra ethyl could suddenly be placed in the hands of hundreds of thousands of users without an exhaustive examination under government auspices and without the imposition of special official regulations governing its sale and use. He bases this view upon the fact that the effects of lead poisoning are cumulative and that as time goes on the careless will tend to relax any precautions they may be induced to take, not knowing that some years may be required for the effects of lead poisoning to develop. Actually the public view is that the dangers have been exaggerated by vested interests and that ethyl petrol will be increasingly used.

Regulations for Spanish Potash Production

REGULATIONS governing the production of potash salts in Spain and its exportation during the calendar year 1928 are provided in a recent Spanish royal order according to a report from counsul F. A. Henry, Barcelona.

From the potash mines of Suria, in the Barcelona consular district, there was exported to the United States in 1927, 18,534,059 lb. of potash salts valued at \$345,804, as compared with 1,353,996 lb. valued at \$24,714 in 1926.

According to the regulation maximum production of potash salts of 80 per cent potassium chloride will be 70,000 tons, while the minimum production will be 30,000 tons. The maximum sale price in Spain will be 250 pesetas the ton of potassium chloride of 80 per cent to 85 per cent, while the minimum foreign sale price will be higher by 1 per cent than the minimum price obtaining in Spain in the preceding month.

On the question of the maximum exportable quantity, the Sociedad de Minas de Potasa de Suria will be obligated to keep the national market constantly supplied, and in the event that it should fail to do this at any time, it will be deprived of the right to export 25 per cent of its total production.

Chemical Executives Meet in Washington

CLOSER contact between chemical industry and the U. S. Department of Commerce and more authoritative information on recent international economic developments are seen as the principal results of the second meeting of chemical executives held in Washington Feb. 16, 1928. More than 300 of the leading business men of the industry met at the invitation of Secretary Hoover, in order to receive first-hand reports from representatives in Paris and Berlin, from various officials of the department in Washington, and from the assistant to the U. S. Attorney General, Col. William J. Donovan. Mr. Hoover was unable to be present at the conference and plans for a banquet at which he was to be the principal speaker were, therefore, abandoned.

A. Cressy Morrison, chairman of the advisory committee of the Department of Commerce, presided at the sessions, which, through the courtesy of the U. S. Chamber of Commerce, were held in the National Council Room of its new building. The first speaker, C. C. Concannon, chief of the chemical division, reviewed the recent progress of American chemical industry and technology, in domestic commerce and in foreign trade. Referring to the need for furthering international relations, Mr. Concannon said:

"Unquestionably there are points of contact between the American chemical industry and the industries of Europe through the exchange of patents and processes, and there can be no criticism of a development of this kind, which is logical and which has the enduring features not possessed by blanket agreements between nations or composite groups within nations. This character of participation in the chemical industry of Europe is a form of American penetration that is salutary and will undoubtedly serve to strengthen our position both at home and abroad."

Dr. Julius Klein, Director of the Bureau of Foreign and Domestic Commerce, stressed the necessity for improving our distribution machinery. His address is printed on pages 168 and 169 of this issue. In a like manner Edwin W. Ely of the Division of Simplified Practice, showed the commercial advantages to the chemical industry that would result from the elimination of useless standards, container sizes, shapes and varieties. Thomas W. Delahanty, assistant chief of the chemical division, presented a thoughtful paper on "Opportunities in Export Trade."

THE afternoon session was opened by Colonel Donovan's review of legal defenses available to the domestic chemical industry in combating the international cartel and similar combines. He held that while it is not possible to prevent the foreign monopoly from entering the American market, it is possible to make that monopoly conduct its business according to the laws of this country. The Supreme Court has re-

cently shown that a provision of the Wilson Tariff Act of 1894, which had never previously been enforced, is an effective means of curbing unfair foreign competition. The Webb-Pomerene Act permitting co-operative exporting and the activities of the legitimate trade association were cited as additional means of defense.

Probably most popular interest centered in the comprehensive review of recent economic and technical developments in Germany and France presented by William T. Daugherty, trade commissioner at Berlin, and Daniel J. Regan, assistant commercial attaché at Paris. Mr. Daugherty's paper appears elsewhere in this issue. Both speakers emphasized the tendency toward centralization and the apparent desire of the leaders of foreign chemical industries to frame agreements with American chemical firms.

Following the addresses there was an open forum in which questions were answered by Assistant Director, T. R. Taylor and the commodity and division chiefs of the Bureau of Foreign and Domestic Commerce. Among the subjects discussed were advertising, collections, credit ratings, distribution surveys, foreign loans, foreign tariff, packing, synthetic rubber, and rayon and synthetic textiles.

Lime Association Will Meet in New York

THE annual convention of the National Lime Association will be held at the Belmont Hotel, New York City, on May 23-24. The most emphatic note in the announcement of the Convention Committee is that this is to be a meeting of the industry, rather than of the association, thus recognizing that the industry must be given a time and place to discuss the conditions of the industry.

To carry out this purpose there is to be no program for the convention. Members and others are submitting questions bearing directly upon conditions which prevail in various sections of the country, and these questions will serve as the basis of round table discussion. The chairman will be S. W. Stauffer, of the J. E. Baker Company, York, Pa.

In order that there shall be no restraint whatever, and that the discussion may be strictly free, the convention will not be reported for the publishing of proceedings.

One, probably two, outstanding men will address the convention, and arrangements are under way with two men whose names will be sufficient urge for every lime manufacturer to attend.

The Convention Committee is headed by S. W. Stauffer, assisted by A. B. Mack, assistant to the president, Kelley Island Lime and Transport Company, Cleveland, and G. B. Arthur, general manager of the National Lime Association.

France Develops New Use for Waste Liquors

From Our Paris Correspondent

ATTENTION has been attracted to a new and uncommon use of waste liquors resulting from the manufacture of paper-paste. The manufacturing of papers produces, it is known, waste liquors of about the same weight as the paste obtained. These residuary liquors come from the treatment of wood shavings by sulfite soda lyes. They were disposed of as waste until quite recently. As these residuary liquors contain colloidal matters, particularly tannic acid and resin, several industrial processes have been tried, and patented, for the recovery of the tannin contained.

The agglomerating properties of these lyes have been utilized in the French foundry trade for the making of cores for foundry pieces, particularly by the Société l'Avébène. This firm, in 1922, developed a device concentrating the sulfite lyes of all the paper factories near Rouen. This condensed product was called "Protector." "Protector" is now used for agglomerating road ballast and the dusting of macadam roads. It is a dark brown viscous liquid with adhesive qualities. Its density is about 2.3 and it contains small proportions of sulphuric acid. Since 1924 the use of "Protector" has been adopted for the making and maintenance of roads, after many satisfactory trials had been made mostly near Rouen.

At first "Protector," diluted with water, was used only for dusting roads. Excellent results having been obtained the Road Survey used "Protector" as a liquid cement for agglomerating road ballasts, thus making concrete roads with "Protector" as a cement. No opinion can be given yet on the value of sulfite soda liquors for road making as this process has been used only quite recently but it may be safely stated that this new road covering cannot compete for firmness and resistance with modern bituminous asphalt or cement coverings. Its only advantage is its cheapness and it may at times be used as a substitute for tar for the smaller traffic roads on condition that the road ballast used contains the necessary agglutinative limestones.

French tar production is insufficient for the home industries and road-making needs. On the other hand bitumen must be imported, thus making its use very expensive; these are the reasons that make it a necessity in France to utilize this byproduct of the paper factories. At present the latter may supply yearly about 100,000 tons of sulfite soda liquor for road making or repairing. Needless to say the technical side of the problem is being earnestly studied and improved upon.

The recent opening of the warehouse at Antwerp has aided materially in handling Alsatian potash. It is located so that all-water deliveries can be made and 140,000 tons of potash can be stored with latest mechanical appliances for loading and unloading.

News in Brief

THE PITTSBURGH SECTION of the American Ceramic Society will hold a joint meeting with the Pittsburgh Section of the American Chemical Society on March 15. Dinner will be served at the Pitt Faculty Club. A motion picture, "The Story of Refractories," will be shown at the Bureau of Mines. Francis C. Flint, chief chemist for the Hazel-Atlas Glass Co., will speak on "Recent Developments in the Glass Industry."

REPORTS from Germany state that the German Potash Syndicate has announced that production of pure potash in Germany last year amounted to 1,239,372 short tons, as compared with 1,099,873 short tons in 1926.

TWO RESEARCH FELLOWSHIPS in engineering are to be appointed on April 30 by the University of Wisconsin. Candidates must be graduates of engineering colleges of recognized standing, and, preferably, should have had one or two years of graduate study, of teaching, or of engineering experience. The appointments will be for a period of two years, subject to satisfactory service, and the salary will be \$900 for the first year and \$1,100 for the second year. A fellow will be expected to devote not less than half time to assigned research in the College of Engineering, but will be given an opportunity to complete the requirements for a master's degree within the two-year period.

ANNOUNCEMENT has recently been made of the consolidation of the Evans Lead Company and the Golden Rod Mining & Smelting Corporation. The consolidated company will be known as the Evans-Wallower Lead Company with Edgar Z. Wallower, president; Ray M. Evans, vice-president, and Louis M. Atha, treasurer.

ALUMINO-THERMIC CORPORATION has received favorable decision in the case of Alumino-Thermic Corporation-H. G. Spilsbury, H. J. Barnes vs. Goldschmidt Thermit Company. Decision reversing lower court was filed holding Thermit Process Patent No. 900366 invalid; holding also that the Alumino-Thermic Corporation's Feralite Rail Welding Process does not infringe so that rail welding by their under-cutting or full width insert methods is permitted. Goldschmidt Patent No. 1075709 was held valid but of minor importance.

COMMERCIAL ATTACHÉ F. W. ALLPORT, Berlin, states that according to a report current in Berlin the I. G. Farbenindustrie has reached an agreement with the Societa Montecatini whereby the latter will obtain the benefit of German experience in the production of synthetic fertilizer materials. A Rome report stated that Montecatini had recently commenced the manufacture of ammonium sulphate-nitrate and calcium nitrate, two I. G. specialties,

which would tend to confirm the Berlin dispatch. It is stated that the I. G.-Montecatini negotiations were concluded without any financial acquisition on the part of the Germans in the Italian company.

ORGANIZATION of the Window Glass Manufacturers' Association was completed, following a meeting of manufacturers in Pittsburgh on February 16. W. L. Monro, American Window Glass Company, Pittsburgh, was elected president. Frank Bastin, Blackford Window Glass Company, Vincennes, Ind., was elected vice-president, and Charles R. Stevenson, secretary and treasurer.

Domestic Supply of China Wood Oil

GOVERNMENT observers who just have inspected the tung oil farms in Northern Florida are convinced that the effort to provide a domestic source for this product has passed beyond the experimental stage. The fact that a large paint manufacturer who has 1,800 acres of three-year trees is going ahead with plans for a large pressing and extracting plant is further evidence that the United States soon will not be entirely dependent on a distant and uncertain source of supply for its requirements of China wood oil. It is recognized that a long period of years must elapse before our large imports of the oil could be displaced but the area of suitable land in Florida is sufficient to permit of the expansion of the industry to that point. As the amount of labor required is small the Chinese producers will have little advantage in the matter of labor cost.

Record Sulphur Production Last Year

THE production of sulphur in the United States in 1927 amounted to 2,111,618 long tons compared with 1,890,027 tons in 1926, an increase of 12 per cent and the largest ever recorded, according to the Department of Commerce. Shipments were practically the same as the record breaking shipments of 1926, being 2,072,109 tons, valued at about \$38,300,000 compared with 2,072,657 tons valued at \$37,300,000 in 1926. Stocks on hand at the mines increased approximately 40,000 tons in 1927, and totaled 2,100,000 tons at the end of the year.

Illinois Chemists Organize

Illinois chemists and chemical engineers are planning a permanent organization to have its first meeting during the sessions of the American Chemical Society at St. Louis, April 16 to 20. A testimonial dinner to Professors S. W. Parr and W. A. Noyes will be held on that occasion according to plans being formulated by Dr. Roger Adams, head of the chemical department at the University of Illinois.

Nitrogen Conference in The Adriatic in April

INVITATIONS have been received by various executives of large American chemical companies to attend an international Nitrogen Conference, in the Adriatic, beginning next April 30. The invitations are issued over the names of: Comptoir Francais de l'Azote, Paris; Montecatini Societa Generale, Milan; Nitram Limited, London; Norsk Hydro-Elektrisk Kvaelfstofaktieselskab, Oslo, and Stickstoff-Syndikat, G. M. B. H., Berlin. These companies comprise the largest nitrogen producers in the world.

Participation of American concerns in the future activities of these foreign manufacturers was forecast by the addresses of W. T. Daugherty, American trade commissioner at Berlin; and D. J. Reagan, assistant commercial attaché at Paris, delivered before the Conference of Chemical Executives in Washington on February 16.

The scope and objects of the Adriatic Meeting will be similar to those of the conference held at Biarritz last year, namely, to put on record the knowledge which has been gained in the interval in regard to fertilizers in their relation to agriculture and to afford opportunity of discussion to those present.

Papers will be read by the following: Dr. J. Bueb, Mr. F. C. O. Speyer, Professor L. Bretigniere, Professor Dr. H. Warmbold, Sir Frederick Keeble, C.B.E., Sc.D., F.R.S., Dr. A. Demolon, Professor Dr. Erwin Baur, Mr. H. J. Paige, M.B.E., B.Sc., F.I.C., Mr. T. H. J. Carroll, B.Sc., and Mr. J. Galland.

The North German Lloyd Steamer "Lutzow" has been chartered and will leave Venice on April 30. The first stop will be at the Island of Corfu. Thereafter various stops will be made on the Eastern Coast of the Adriatic.

Among those invited to be present are the European representatives of the American Department of Commerce and the executives of the Dupont Company, the American Cyanamid, the Allied Chemical, and the Synthetic Nitrogen Products Corporation.

Record Fertilizer Exports from Germany

GERMANY'S nitrogenous fertilizer exports were record-breaking in 1927, topping 1,000,000 metric tons, according to a report to the Department of Commerce. Total exports, including ammonium sulphate and calcium, sodium and potassium nitrates reached 1,019,903 metric tons compared with 631,177 tons in 1926 and 387,860 tons in 1925.

Exportation of calcium nitrate showed greatest increase of any German nitrogenous fertilizer last year, doubling from 126,076 to 268,504 metric tons. Ammonium sulphate increased from 464,065 to 669,880 metric tons, sodium nitrate from 27,929 to 60,276 metric tons and potassium nitrate from 13,107 to 21,243 metric tons.

MEN

in Chemical Engineering

PROF. TREAT B. JOHNSON, internationally recognized for his researches in bacterial chemistry, has been appointed Sterling Professor of Chemistry at Yale University. He has been a member of the faculty ever since his graduation from the Sheffield Scientific School in 1898, where he became successively professor of organic chemistry in 1914 and a trustee in 1920. Professor Johnson, who is also president of the American Institute of Chemists, conducted special investigations for the Chemical Warfare Section of the War Department during the late war.

FRANCIS S. SCHIMERKA, formerly research engineer of the Arizona Copper Company, and for the past seven years connected with the laboratory of Thomas A. Edison in West Orange, N. J., is now at Fort Myers, Fla., with Mr. Edison in his investigation of rubber production from domestic plants.

PROF. S. C. LANGDON has relinquished his teaching post at Northwestern University to take charge of chemical research for the Curtis Lighting, Inc., of Chicago, although he will continue to direct some of his researches at Northwestern.

JAMES OTIS HANDY, director of chemical and metallurgical investigations of the Pittsburgh Testing Laboratory, 72 Washington St., New York, has returned from Montana and Arizona, where he gave expert evidence on behalf of the Anaconda and other copper smelting companies in the litigation based on the metallurgical patents of George Campbell Carson. Mr. Handy will hereafter carry on his work as consultant and investigator in the chemical and metallurgical and prospecting fields so that he will be available in New York and by appointment in Pittsburgh or elsewhere.

C. W. CROWELL, plant superintendent and chemical engineer of the Pacific Chemical Company for over four years, has resigned his post to accept a position as chemical engineer for the Southern Glass Company, Los Angeles, Calif.

O. S. DOOLITTLE, formerly New York representative and sales manager of the Semet-Solvay Company, has been made vice-president of the American Fluoride Company, New York City.

P. C. BROOKS was recently elected a vice-president of Fairbanks, Morse & Company, with whom he had been connected for 29 years. He is also president of the subsidiary E. & T. Fairbanks Company.

HUGH STOTT TAYLOR, head of the department of chemistry at Princeton, was officially presented with the Nichols Medal for 1928 on March 9 after a joint dinner given by the New York section of the American Chemical Society and the American Electrochemical Society.

The medal was bestowed in recognition of Professor Taylor's fundamental work on catalysis, a subject



HUGH S. TAYLOR

which he then treated in his speech of acceptance, particularly stressing the benefit to be derived by research from contact with the industry.

PROF. JAMES KENDALL, dean of the school of chemistry at New York University, has accepted the chair of chemistry at the University of Edinburgh to succeed Sir James Walker, his former teacher there. Prof. Kendall will leave this country at the end of the present school year.

DR. EDGAR FAHS SMITH was guest of honor at the annual dinner of the Chemists' Club in New York, Feb. 29. A large number of the Club members was assembled, and tributes were paid to Dr. Smith by Allen Rogers, a former student, and Josiah H. Penniman, provost of the University of Pennsylvania.

DR. HECTOR RUSSELL CARVETH has been elected president of the Roessler & Hasslacher Chemical Company after being vice-president of that firm since 1917. Dr. Carveth, who was born in Canada in 1873, received his B. A. at Victoria and Toronto in 1896 and spent the next nine years instructing at Cornell. Thereafter he was successively with the Acheson Graphite Company and the Niagara Electrochemical Company.

H. C. PARMELEE, editor of *Chem & Met.* and secretary of the American Institute of Chemical Engineers, sails for Europe on the *Cedric*, April 7. He will spend about three weeks each in England and in Germany visiting industrial plants and industrial research laboratories, before returning to the United States about June 2.

DR. HUGH P. BAKER, for eight years executive secretary of the American Paper and Pulp Association, has resigned to accept a post as manager of the Department of Trade Association Service of the U. S. Chamber of Commerce. In a resolution, his former associates expressed their appreciation of his service in the interest of the industry and their wishes for his further success.

R. H. MINTON, general superintendent of the General Ceramics Company, Metuchen, N. J., has resigned after being connected with the organization for the past fourteen years with supervision over all plants of the company in the Raritan River section. He is a past-president of the American Ceramic Society. Pending the development of a new enterprise in the ceramic field, for which plans are now being consummated, Mr. Minton will engage as a consulting ceramic engineer.

SIR JAMES COLQUHOUN IRVINE, principal and vice-chancellor of the University of St. Andrews, Scotland, has accepted an invitation to take a leading part in the Institute of Chemistry of the American Chemical Society which meets in Evanston, Illinois, from July 23 to August 18, 1928. His acceptance is particularly fitting since he was the principal European guest at the chemical sessions of the Institute of Politics at Williamstown in 1926 when the idea of an Institute of Chemistry was first conceived.

CHARLES E. STONE, since 1924 vice-president of the Interstate Drop Forge Company, Milwaukee, has been elected president succeeding C. R. Messinger, who is a member of the board of directors and president of the Chain Belt Company.

VAN CORTRIGHT MEKEEL, formerly with the Taylor-Wharton Iron & Steel Company of High Bridge, N. J., has accepted a post as special representative of the Nugent Steel Castings Company, Chicago, Ill.

KARL B. THEWS, formerly vice-president of the Pittsburgh Lacquer & Chemical Company, has joined the Thews-Harbison-Thews, Inc., Philadelphia, with charge over the chemical division.

R. J. SNELLING is now in direct charge of lacquer research work with Thews-Harbison-Thews, Inc., after being general manager of the Pittsburgh Lacquer & Chemical Company.

DR. WILLIAM HOWLETT GARDNER has been appointed research fellow on shellac and its properties at the Polytechnic Institute of Brooklyn. Dr. Gardner graduated from Cornell University in 1923, became an instructor in chemistry at Dartmouth College for three years, and was later research chemist for the Vitreous Enameling Company, Cleveland.

A. W. AMBROSE, manager of production, Empire Companies, Bartlesville, became chairman of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers. He is successor to John M. Lovejoy, general manager of the Amerada Petroleum Corporation.

H. W. CAMP, superintendent of refineries for the Empire Companies, Tulsa, is the new vice-chairman for refinery engineering in the A.I.M.E.

H. F. T. ERBEN, assistant vice-president of the General Electric Company, retired on January 1, 1928, after more than 40 years of service with that company. At the time of his retirement he was also vice-chairman of the General Electric manufacturing committee.

CHARLES GLASS, for the past seven years with the Wilson Chemical Company, has severed his connection with that firm.

I. H. ODELL, JR., has resigned his post with the Mellon Institute to accept a position as chemical engineer with the dry color division of E. I. du Pont de Nemours & Company, Inc., Newark, N. J.

DR. GEORGE OTIS SMITH, director of the U. S. Geological Survey, was elected president of the American Institute of Mining and Metallurgical Engineers at the general session in New York City on February 23. He succeeds E. De Golyer of New York in his new capacity.



Harria & Kving

GEORGE OTIS SMITH

OBITUARY

EARNEST A. HAYES, Chicago district manager of The Patterson Foundry & Machine Company, died unexpectedly in Brooklyn, N. Y., on February 16 at the age of 35. He had formerly been with the U. S. Rubber Company and the Duriron Company.

CHARLES P. HUGO SCHOELLKOPF, for many years vice-president of the Niagara Falls Power Company, died on February 25 in New York City after a prolonged attack of pneumonia. Born in Buffalo 65 years ago, he received a technical education here and in Germany, and in the course of his career became associated with the Schoellkopf dye plant and its successor, the National Aniline and Chemical Company which has since become a part of the Allied Chemical and Dye Corporation.

JOHN T. BARRY, president of D. D. Williamson & Company, manufacturing chemists, died at his home in Brooklyn, N. Y., on March 5 at the age of 59.

ROBERT W. NEFF, for many years prominent in the American Chemical Society and a councilor of the North-eastern Section, died on February 4 after a brief illness from which he was presumably convalescing. Mr. Neff was born in 1858, and after attending the Brooklyn Polytechnic Institute, soon became active in textile chemistry, a field in which he later specialized.

CALENDAR

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, convention, New York City. Dec. 27, 1928-Jan. 2, 1929.

AMERICAN CERAMIC SOCIETY, tour through France, Germany, Czechoslovakia and England, May 19-July 16.

AMERICAN CHEMICAL SOCIETY, spring meeting, St. Louis, April 16-20.

AMERICAN ELECTROCHEMICAL SOCIETY, spring meeting, Bridgeport, Conn., April 26-28.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, tour, with British Institution of Chemical Engineers, Quebec, Shawinigan Falls, Montreal, Ottawa, Kirtland Lake, Port Colborne, Niagara Falls, Akron, Pittsburgh, Wilmington, Edgewood, Washington, and New York, August 18-Sept. 2.

AMERICAN REFRACTORIES INSTITUTE, annual meeting, White Sulphur Springs, W. Va., May 8, 9.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, spring meeting, Pittsburgh, May 14-17; regional meetings, St. Paul-Minneapolis, Aug. 27-29, Boston, Oct. 1-3.

AMERICAN SOCIETY FOR TESTING MATERIALS, group meeting, Washington, D. C., March 20-23.

AMERICAN WELDING SOCIETY, annual meeting, New York City, April 25-27.

INSTITUTE OF CHEMISTRY OF THE AMERICAN CHEMICAL SOCIETY, second session, Evanston, Ill., July 23-August 18.

NATIONAL FOREIGN TRADE COUNCIL, 15th convention, Houston, Texas, April 25-27.

NATIONAL LIME ASSOCIATION, 1928 convention, New York City, May 23, 24.

INDUSTRIAL NOTES

THE ROESSLER & HASSLACHER CHEMICAL COMPANY, New York, announces the following changes in organization: W. A. Hamann, chairman of the board; H. R. Carvette, president; P. Schleussner, first vice-president; A. Frankel, treasurer; P. S. Rigney, secretary.

THE STANDARD OIL COMPANY OF N. J. has reorganized the development department, general engineering department, and the Standard Development Company into the Standard Oil Development Company.

The officers are: President, E. M. Clark; vice-presidents, F. A. Howard, C. H. Haupt, C. A. Straw; secretary, M. H. Eames; treasurer, R. P. Resor.

Executive Committee: E. M. Clark, F. A. Howard, C. H. Haupt, C. A. Straw, C. O. Johns, R. T. Haslam, E. W. Dean, Roger Chew.

THE AMERICAN ELECTRIC MOTOR COMPANY, Cedarburg, Wis., has recently become a subsidiary of the Splittorf-Bethlehem Electrical Company, Newark, N. J., with W. R. Davis as general manager.

THE MORSE CHAIN COMPANY has appointed T. M. Manley, manager of the northern New York district, with headquarters at the main office in Ithaca, N. Y.

THE KOPPERS CONSTRUCTION COMPANY is having a 32-story building erected at Grant Street and Seventh Avenue, Pittsburgh, Pa. It plans to reserve the fourth to fifteenth floors for its own purposes.

THE STRUTHERS-WELLS COMPANY, Warren, Pa., has opened a branch office at 332 South Michigan Ave., Chicago, with A. B. Noyer in charge.

THE SUCHAR PROCESS CORPORATION announces the removal of its offices and laboratories to 72 Wall St., New York City.

THE JOUBERT & GOSLIN MACHINE AND FOUNDRY COMPANY, Birmingham, Ala., has recently purchased the Valley Rotary Filters Company of Bay City, Mich.

THE MANHATTAN RUBBER MANUFACTURING COMPANY, Passaic, N. J., has elected John H. Merrell vice-president and A. S. Hardy a director.

WISNICK-TUMPFER, INC., has opened a Trenton office in charge of R. F. McGrory, manager of the rubber division. This firm recently purchased the controlling interest in the Century Carbon company.

TRUEMPY, FAESTY & BESTHOFF, INC., 75 West Street, New York City, have been appointed sole agents for potash and alkaline salts in the United States, Canada and Cuba by the Konsolidierte Alkaliwerke, Hannover, Germany.

THE FRANK M. COMRIE COMPANY announces the election of Thomas F. Lannin, formerly with Wm. H. Rankin Company and Critchfield & Company, as vice-president and a director.

THE BRIDGEPORT BRASS COMPANY has elected Charles E. Beardsley, president of Beardsley & Wolcott Manufacturing Company, president and director to succeed Carl R. Dietz.

THE ALLIS-CHALMERS MANUFACTURING COMPANY has placed E. D. Hill in charge of an office at 42 Church St., New Haven, Conn.

THE ERIE CITY IRON WORKS has established a district sales office at 122 South Michigan Ave., Chicago, with Charles B. Acheson as manager and J. R. Le Vally as special engineer.

THE PHILADELPHIA QUARTZ COMPANY has appointed J. Passmore Elkinton sales director, Edwin A. Russell sales manager, and Carl F. Wolcott field assistant sales manager.

THE H. P. JONES & COMPANY, Toledo, Ohio, has expanded its engineering activities to handle industrial chemical problems.

THE FERRO ENAMEL SUPPLY COMPANY, Cleveland, Ohio, announces the appointment of B. H. Hale as Eastern sales manager and J. A. Rumer as Western sales manager.

THE DORR COMPANY announces the departure of its representative, Arthur Terry, on January 28 in order to visit South Africa in his company's interest for four or five months.

DISPERSIONS PROCESS, INC., has acquired all the assets of Research, Inc., and its subsidiary, Aqua Rubber Company, Boston. After March 15 the general address will be Dispersions Process, Inc., Oaks, Montgomery County, Pa.

THE AMERSIL COMPANY, INC., 88 Cypress Ave., New York City, is the name of a new firm manufacturing fused silica products. The plant and staff of the Sidlo Company of America have been taken over, and the officers are O. C. Trautman, president, and F. W. Lovejoy, treasurer and general manager.

MARKET CONDITIONS and PRICE TRENDS

Increased Production of Chlorine May Cause Oversupply

New producers and enlarged outputs coincide with smaller demand from the paper trade and other consuming industries.

BECAUSE of the difficulty in storing bleaching powder in the hot-weather period, there have been years when sales of this chemical have been made at very low prices. Surplus stocks even have been destroyed in the summer months because a market for them could not be found. In recent years there has been a decline in the output of bleaching powder owing to the growing preference for liquid chlorine.

The fact that surplus stocks existed was regarded as evidence that productive capacity was in excess of consuming requirements. Recent growth in consuming outlets has not obviated this condition since chlorine producing plants also have been enlarged and in the latter part of last year a new producer entered the field.

According to the latest census figures—those for 1925—domestic production of chlorine was placed at 166,325,643 lb., of which 61,365,457 lb. was consumed at the point of origin and 104,960,186 lb. offered for sale. These figures do not include chlorine made and consumed in the paper and wood-pulp industries. The census figures for 1925 evidently falls considerably short of total production of chlorine as may be shown by reference to figures for caustic soda production by the electrolytic method during the same year. The output of electrolytic caustic soda was 134,053 tons and as practically equal amounts of chlorine were produced in this process, that total should be fairly representative of chlorine production for that year.

THE pulp and paper trade is the largest consumer of chlorine. Last year production of pulp and paper in this country and Canada was large enough to create heavy accumulations in sellers' hands and a check was placed upon production in order to give an opportunity to work off surplus holdings. This was the condition which confronted the industry at the beginning of the year and latest reports on pulp

and paper manufacture indicate a production program below that of last year. Furthermore, curtailed production is predicted for coming months. Naturally this is a factor in the chlorine trade and accounts for reports that current demand for chlorine and bleaching powder is of a disappointing nature.

The outlet for chlorine also has been narrowed somewhat by a declining tendency in export trade in bleaching powder. After the war a substantial business in bleaching powder was built up with foreign countries and in 1921 outward shipments amounted to close to 19,000 tons. Last year export commitments amounted to less than 8,000 tons.

IN THE latter part of last year, contract prices for 1928 deliveries of chlorine were announced by leading producers. The new prices represented a decline of one-half cent per lb. on tank car business. The lower level of prices was rumored to be due to an effort to head off production on the part of some large consumers but more probably was the result of a new producer in the field and consequent keener competition among sellers. A large volume of business followed the establishment of the new prices but contract placements did not equal the tonnage placed in the preceding season and buying since the turn of the year is reported to have been of relatively small volume. It is becoming evident, therefore, that while large amounts of

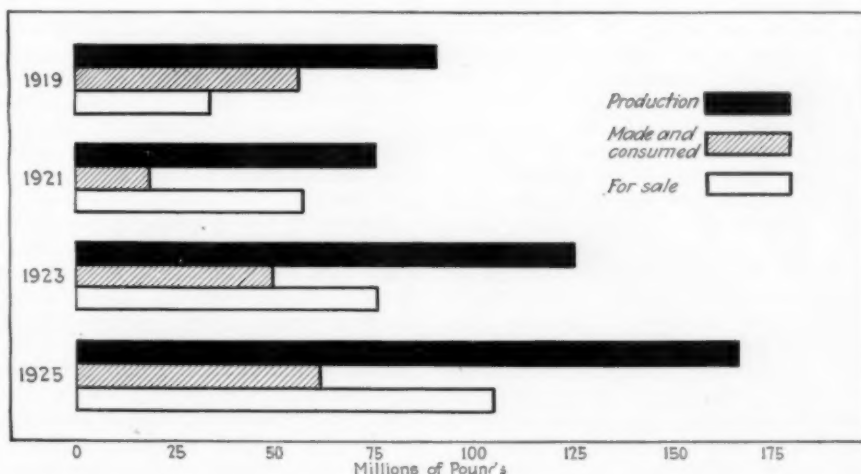
chlorine will be demanded this year, a market can hardly be found for a production equal to that of 1927. In the face of reported enlarged outputs, this gives rise to speculation regarding the stability of present prices. In some quarters it is held that selling pressure can be averted only by a more harmonious arrangement between supply and demand.

BECAUSE of the close connection between production of chlorine and caustic soda it is not easy to control the output of the former if the producer also is obligated by the necessity for making contract deliveries of the soda product. In the past there have been occasions when chlorine producers ceased operations temporarily because of accumulations of chlorine and purchased caustic soda from producers employing the ammonia-soda process in order to carry out existing contracts.

The greater part of chlorine production is marketed in the form of liquid chlorine and bleaching powder. Estimates for 1927 placed production of liquid chlorine at 65,000 tons and bleaching powder at 45,000 tons. Considerable quantities of chlorine also are used in making hypochlorites, hydrochloric acid, carbon tetrachloride, and different coal-tar chemicals. While chlorine production is controlled by manufacturers of chemicals, limited amounts are turned out by paper plants for their own consumption and some production also is reported on the part of waterworks for use in water purification.

Census figures are taken as a basis for the following graph and the figures do not take into account the amounts produced outside the regular industry.

Chlorine Production 1919-1925



ECONOMIC INFLUENCES *on production and consumption of* CHEMICALS

Output of Chemicals Lower Than in Corresponding Period Last Year

Manufacturing Operations Maintain High Levels
But Fall Short of 1927 Standards

REPORTS on industrial production are of a conflicting nature. Some of the basic industries are progressing in a very favorable way. Steel production, which is one of the barometers of general business, made splendid progress last month; in fact it was the best February in the history of the industry. Operations in that month, based on theoretical capacity of 57,230,350 gross tons annually, were at a rate of 87.27 per cent of capacity as compared with 82.79 per cent for the preceding month and 85.62 per cent for February, 1927. With estimated production for January-February at 7,975,983 tons as against 7,541,253 tons for the corresponding period of 1927, a gain of 5.76 per cent in steel production is shown in the first two months of the year.

Pig iron production fell off in February and for the two-month period there was a decline of approximately 4.5 per cent in comparison with the corresponding 1927 period. Building contracts, according to factors specializing in that field, are running considerably above those of last year. This is in keeping with reports from the lumber industry for which larger outputs are claimed, although weather conditions have interfered with recent operations.

WHILE the position of basic industries has a more or less direct bearing on production and distribution of chemicals, a more accurate view of the status of chemical production may be gained from a consideration of the trader which are the largest consumers of chemicals. As compared with 1927, the largest percentage of gain for the year to date, in the movement of chemicals has been experienced in those selections which enter into fertilizer manufacture. Two of the important fertilizer materials—potash and nitrate of soda—have but little influence on domestic productive activities, since the major sources of supply are located outside this country. But increased fertilizer output is directly reflected in larger domestic production of sulphate of ammonia, sulphur, sulphuric acid, phosphate rock, and the animal ammoniates. In passing, it may be mentioned that the home output of sulphate of ammonia is proving inadequate and with very little expansion in sight, there remains the alternative of curtailing

consumption or of increasing importations this year, with the latter course probable.

Fertilizer tags sold in cotton-growing states for the seven-month period August-February were larger than in the preceding year but smaller than in the 1926 season and with the movement, recently started, to reduce cotton acreage 10 per cent, production of mixed fertilizers may be placed on a less active scale for the remainder of this season.

THE paint and varnish and soap industries coincide in this respect that very little change is anticipated from production standpoint as referred to 1927. Changes within the paint and varnish industry are causing a readjustment in the quantities of raw materials used but this has no material effect on consumption of chemicals since the falling off in demand for some selections is offset by increased call for other chemical products as is evidenced by the large volume of solvents now consumed by that industry. Nevertheless, it is apparent that to equalize paint and varnish production with the output of last year, building operations and automobile production schedules must be maintained on a plane equal to that of last year. Furthermore, consumption of paints and varnishes for renovating and protective purposes will depend largely on the state of general business about which there is some uncertainty.

With curtailment of mineral oil production and smaller runs to stills, the use of chemicals for oil refining so far this year has been on a reduced scale. No change in existing conditions is expected in the near future and this outlet for chemicals may be narrowed throughout the year. Low prices for fats, also are cutting into the fields of edible oils and vegetable oil refining does not promise to equal last year's activities.

The tariff commission is now considering the petition for higher import duties on glass but in the meantime foreign competition is active and domestic plate glass production in January was more than 3 per cent under that for January, 1927. Pulp and paper manufacturers are carrying out a program of curtailment pending the disposition of surplus stocks and this is necessarily reflected on demand for

chemicals from that quarter. Manufacture of explosives in January was 12.5 per cent below January, 1927.

In the absence of definite output figures, employment indexes afford a basis of comparison for dyeing and finishing textiles. The indexes represent an increase of 1.7 per cent for January over January, 1927. On the same bases chemical production declined 3 per cent last January and activities in the leather industry were off 2.6 per cent.

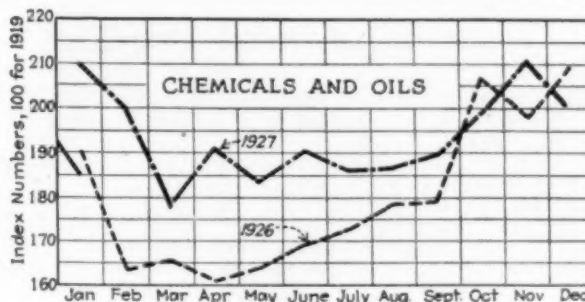
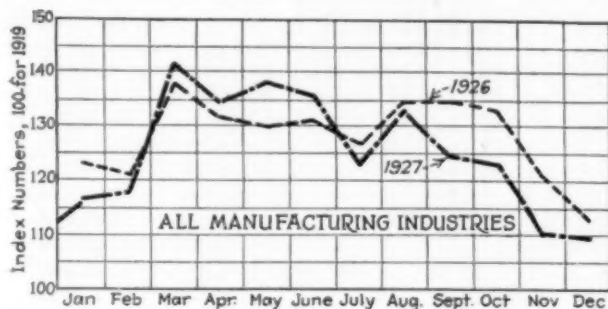
Summing up industrial production with reference to its bearing on chemical consumption, the premises lead to a conclusion that distribution of chemicals since the first of the year has fallen below the standards for the corresponding period of last year.

THE output of raw materials in January as reported by the Department of Commerce, was smaller than in either the previous month or in January, 1927. Contrasted with the previous month, all groups showed smaller production, but as compared with a year ago, marketings of animal products and the output of forest products showed increases, other groups declining. Manufacturing production, after adjustments for seasonal conditions, was larger than in December but smaller than a year ago. As compared with the previous month, all groups showed larger output except paper and printing, which showed no change, and chemicals and oils and stone and clay products, which declined. As compared with a year ago, increases were registered in foodstuffs, iron and steel, lumber, leather, and stone and clay products, all other groups declining.

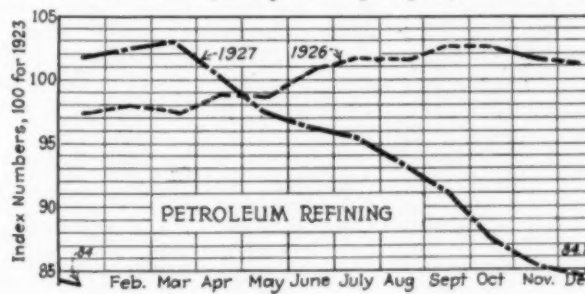
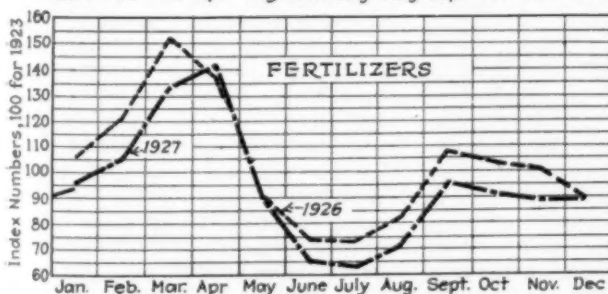
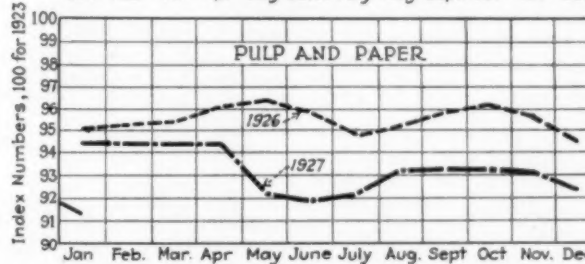
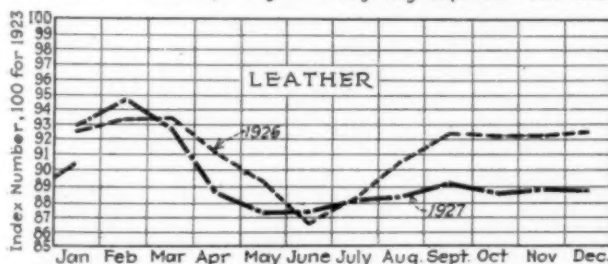
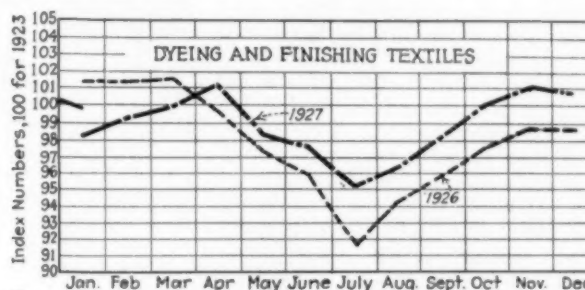
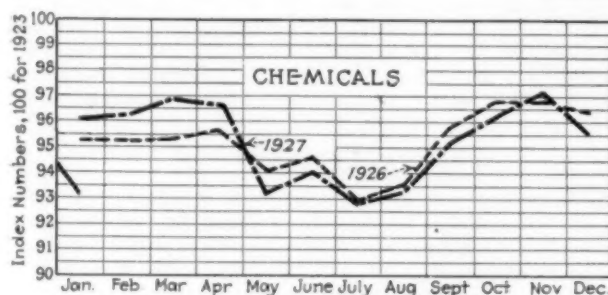
Stocks of commodities held at the end of January, after adjustments for seasonal conditions, were lower than at the end of either the previous month or the same month of last year. As compared with the previous month, the decline in the general index was solely due to lower holdings of foodstuffs, both raw and manufactured, other commodities showing increased holdings. As compared with a year ago, all groups were held in larger quantities except raw foodstuffs, the decline being sufficient to more than offset increased holdings of manufactured foodstuffs, other manufactured commodities, and raw materials, other than foodstuffs.

Unfilled orders at the end of January were larger than at the end of the previous month but smaller than a year ago. As compared with the previous month all groups showed larger forward orders but as compared with a year ago, increased orders for iron and steel were insufficient to offset declines in other groups.

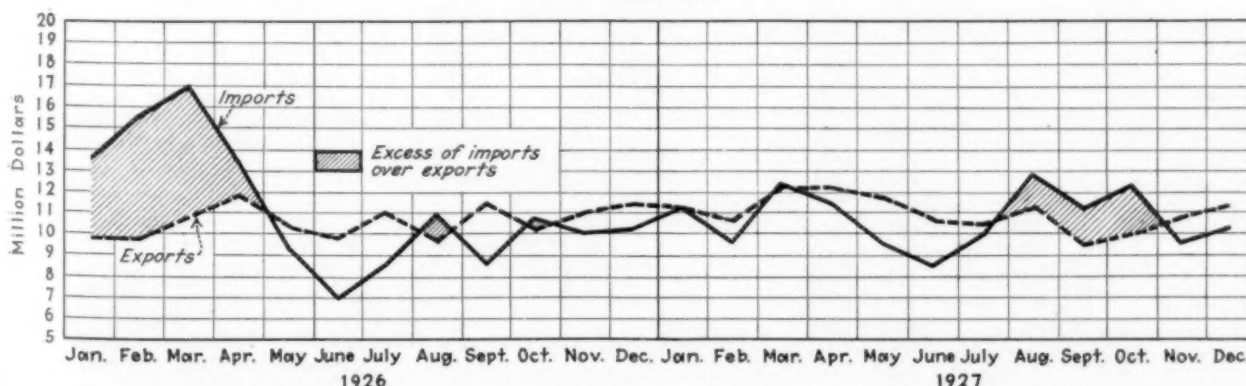
INDEXES OF ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



VOLUME OF PRODUCTION (U. S. Dept. of Commerce)



FACTORY EMPLOYMENT (U. S. Dept. of Labor)



MARKET CONDITIONS *and* PRICE TRENDS

Irregular Conditions in Market for Chemical Products

Surplus Stocks and Shortage of Prompt Supplies Found in Present Market

THE PREVALENCE of spotted conditions in the market for chemicals is becoming more apparent as more definite information becomes available relative to the varying positions of consuming industries. Demand for chemicals from some directions has not been active since the first of the year. As production has been kept on a high plane, stocks in producers hands have increased and selling prices have been none too firm. In other cases there is a decided shortage of supplies and the spot market has maintained a premium over forward positions.

Acetate of soda is included among the selections which have been in limited supply. Demand from the textile and dye industries has been larger than anticipated and as production of this chemical has been curtailed in the last two years, there were no reserve stocks to fall back upon and prices for prompt deliveries have been strengthened.

Greater importance, however, attaches to the strong position of sulphate of ammonia. Domestic production for this year had been well sold ahead and as orders came in for additional lots for fertilizer account, it was found that the output was taken up by contract deliveries. Producers of sulphate in an effort to increase production entered the market for ammonia liquor but found a sold out condition. Increased demand for ammonia liquor from nitric and sulphuric acid manufacturers has helped to absorb production and with contract commitments of large volume, prospects favor a strong market for ammonia products for some time to come. Imports of sulphate of ammonia in January amounted to 5,448 tons valued at \$240,021. Practically all this sulphate came from Germany. Very little hope is held out that domestic production of sulphate will be increased and higher prices for ammonia products in general will occasion no surprise.

REVERTING to overproduction it is pointed out that receipts of turpentine and rosin are usually at a rather low level during the last three months of the naval stores year, which ends with March. Substantial decreases in receipts of both commodities are shown in January, compared with December, but in both instances receipts in January this year were slightly larger than in the same month a year ago. Stocks of both commodities decreased in January compared with December, but were greater than a year ago. Receipts of

both commodities during the first ten months of the naval stores year have been greater than during the same period of any of the past 10 years.

Stocks of turpentine at the end of January were larger than at the same time of any year since 1919, and supplies of rosin, while larger than at the end of January, 1927 or 1926, were smaller than at same time of any other year since 1920.

ALCOHOL was featured by a drastic cut in quoted prices which generally was interpreted as an indication that diminished consumption in the anti-freeze trade had left an oversupply in sellers possession. While this condition undoubtedly is true, the decline in price was rumored to have been precipitated by sales in one quarter at levels below those generally maintained. This price cutting was said to have extended to small lots and while concessions on quantities involving 100,000 gal. were said to be common, the small-lot market was maintained until it was found out that exceptions were being made and the general price decline followed.

Methanol while showing no open price change was weak throughout the month and buyers were in a position to dictate terms. Production of crude methanol in January was a little higher than in December but was off more than 20 per cent as compared with January, 1927. On the other hand production of refined methanol was 496,073 gal. in January, 1928 and 480,448 gal. in January, 1927.

Chlorate of soda which has been maintained at a steady price level for many months was reduced in price during the month. The lowering in price was said to have resulted from reports that factors were to enter the production field. Incidentally, it has been rumored of late that one of the largest producers of chlorate of potash was contemplating taking up production of this chemical.

ACID manufacturers are taking regular monthly deliveries of sulphur and prices for the latter appear to be well established. Figures for domestic production of sulphur in 1927 have just been issued and show that 2,111,618 long tons were produced. This was the largest yearly output ever recorded but it was only a little higher than the tonnage shipped from mines. This is the first year since the closing down

of sulphur mines, Louisiana, in 1924 that the production of sulphur has been equal to or larger than the shipments. More than 99.9 per cent of the production was made by two companies in Texas, while more than 99.9 per cent of the shipments was made by these companies and the company in Louisiana which is still shipping from stocks. Production and shipments of sulphur were also made by two other mines, one in Nevada and one in Utah.

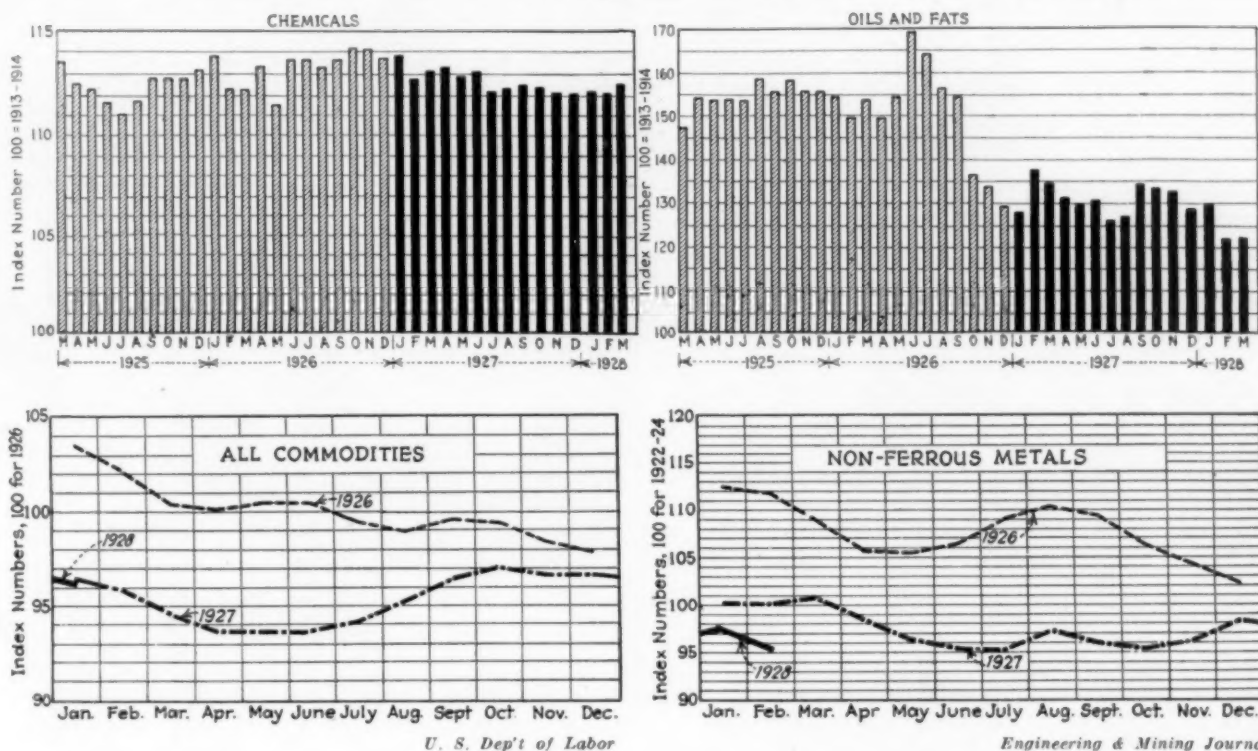
The output of pyrites increased from 166,559 long tons in 1926, to 215,786 tons in 1927, or nearly 30 per cent in quantity, and was the largest output recorded since 1920. The quantity sold or used by producing companies also showed a large increase, from 163,217 tons in 1926 to 206,723 tons in 1927, or 27 per cent. California and Virginia produced the entire tonnage recorded for 1927.

Imports of pyrites in 1927 showed a decrease of 32 per cent in quantity and 24 per cent in value, from 366,151 long tons in 1926, to 250,794 tons. Of the total quantity imported in 1927 Spain furnished 241,581 tons and Canada the remainder.

The increase in domestic production was not large enough to offset the drop in imports of pyrites in 1927, so that there was a decrease of about 66,000 tons in the quantity of pyrites made available for consumption.

OF OUTSTANDING importance in the vegetable oil industry was the bill introduced in the Senate and favorably reported by the Committee on Agriculture and Forestry. The bill proposes changes in the contracts under which cotton oil handled on the New York Produce Exchange. The purpose of the bill is to provide a dependable cotton-oil option contract for the accommodation of the trade in cotton oil and cotton oil products, and to protect the producer of crude oil and the grower of cotton seed from market manipulation.

The report of the committee, among other things, said it appeared that those manufacturers, refiners and processors who use the New York Produce Exchange by making option contract sales to hedge their purchases of crude oil, or other oils, have a decided advantage in tendering oil under their contracts over the producers of crude oil, who make option purchases to hedge in the course of their business, or others who make purchases for speculation. The advantage arises from the provisions of the cotton oil option contract of the New York Produce Exchange, which limits delivery under the contract to "prime summer yellow cotton seed oil," and specifies that the oil must be delivered "in wooden barrels of 400 pounds each."

CHEM. & MET. *Weighted Indexes of PRICES*

Surplus Stocks Give Weak Undertone To Prices for Chemicals

DESPITE the fact that the weighted index number for chemicals shows an advance for the month, underlying conditions do not point to an upward trend for values. In many cases production has proceeded at a pace in excess of consumption and this has resulted in accumulations in sellers' hands. In the last few weeks, there has been a slowing up in contract withdrawals and the stability of prices is threatened by a continued disproportion between production and consumption.

The movement of chemicals since the first of the year has been large, judged by ordinary standards, but has suffered in comparison with that for the corresponding periods of 1926 and 1927 which years witnessed marked expansion in demand for the majority of chemicals. At present consuming de-

mand is spotted with some industries in an active position and others cutting down their requirements for raw materials. Reduced to a common denominator, consumers of chemicals are estimated to have taken so far this year, about 95 per cent of the tonnage which had passed to them in the corresponding period of 1927. This condition, if correct and if carried on throughout the year, would result in a large production and distribution of chemicals. A falling off in consumption, however, if not offset by a corresponding decline in output is a violation of the law of supply and demand and usually results in keen competitive selling with instability of market prices.

Glycerine and naval stores, which in the last year, have been outstanding examples of excess production, have changed but little during the month. Future prices for glycerine are largely dependent upon the status of consuming demand but it is probable that the market will favor buyers before a turn for the better occurs. Naval stores are thought to be about at bottom levels and if holders do not press sales a gradual improvement in values may follow in spite of the fact that new crop offerings soon will be available.

COTTONSEED oil, because of the greater tonnage involved, is the most important single factor in influencing average values for oils and fats.

Prices for this oil recently have shown a tendency to back and fill with no decided price trend. While present quotations are relatively low, there are no bullish factors in sight to warrant sustained advances from present levels and the large visible supply of oil should result in a lowering of prices unless speculative buying or holding back of stocks should appear as a result of unfavorable news regarding the next cotton crop. In this connection it is important to note that a 10 per cent reduction in cotton acreage is predicted, but this may be regarded with some doubt and as fertilizer sales have been running above those of last year, the outlook does not favor a material decline in production of cottonseed and this, in turn, detracts from confidence in marketing the large supply of cottonseed oil without offering price concessions. Soya bean oil, also, is expected to work in buyer's favor as a result of an unusually large supply of beans in the Far East.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	112.60
Last month	112.11
March, 1927	113.09
March, 1926	112.08

While some of the metal salts were lowered in price, strong markets were reported for sulphuric acid, anhydrous ammonia, nitrate of soda, and sulphate of ammonia. The most important price decline was found in the case of denatured alcohol which was reduced 5c. per gal.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	122.35
Last month	122.02
March, 1927	134.38
March, 1926	152.43

After some fluctuation crude cottonseed oil closed at an advance. Castor oil also was advanced in price. Linseed oil was subject to some shading but was quotably unchanged. Very little change was noted in the position of other vegetable oils. The weighted index number showed a slight increase.

CURRENT PRICES

in the NEW YORK MARKET

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to March 12.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums.....lb.	\$0.13-\$0.14	\$0.13-\$0.14	\$0.12-\$0.13
Acid, acetic, 28%, bbl.....cwt.	3.38-3.63	3.38-3.63	3.38-3.63
Boric, bbl.....lb.	.084-.084	.084-.084	.084-.11
Citric, keg.....lb.	.44-.45	.44-.45	.43-.45
Formic, bbl.....lb.	.11-.12	.10-.11	.10-.11
Gallic, tech., bbl.....lb.	.50-.55	.50-.55	.50-.55
Hydrofluoric 30% carb. lb.	.06-.07	.06-.07	.06-.07
Lactic, 44%, tech., light, bbl. lb.	.13-.14	.13-.14	.13-.14
22%, tech., light, bbl. lb.	.06-.07	.06-.07	.06-.07
Muriatic, 18% tanks.....cwt.	.85-.90	.85-.90	.85-.90
Nitric, 36% carbonyl.....lb.	.05-.054	.05-.054	.05-.054
Oleum, tanks, wks.....ton	18.00-20.00	18.00-20.00	18.00-20.00
Oxalic, crystals, bbl.....lb.	.11-.114	.11-.114	.11-.114
Phosphoric, tech., c'bya.....lb.	.084-.09	.084-.09	.084-.09
Sulphuric, 60% tanks.....ton	11.00-11.50	11.00-11.50	10.50-11.00
Tannic, tech., bbl.....lb.	.35-.40	.35-.40	.35-.40
Tartaric, powd., bbl.....lb.	.36-.37	.35-.36	.31-.32
Tungstic, bbl.....lb.	1.00-1.20	1.00-1.20	1.00-1.20
Alcohol, ethyl, 190 p'f., bbl. gal.	2.704-2.75	2.704-2.75	2.75-3.00
Alcohol, Butyl, dr.....lb.	.19-.20	.194-.204	.204-.21
Denatured, 190 proof			
No. 1 special dr.....gal.	.43-.....	.48-.....	.33-.....
No. 5, 188 proof, dr.....gal.	.43-.....	.48-.....	.33-.....
Alum, ammonia, lump, bbl.....lb.	.034-.04	.034-.04	.034-.04
Chromic, bbl.....lb.	.054-.054	.054-.054	.054-.06
Potash, lump, bbl.....lb.	.024-.034	.024-.034	.024-.034
Aluminum sulphate, com., bags.....cwt.	1.40-1.45	1.40-1.45	1.40-1.45
Iron free, bag.....cwt.	2.00-2.10	2.00-2.10	2.00-2.10
Aqua ammonia, 26%, drums.....lb.	.03-.04	.03-.04	.024-.03
Ammonia, anhydrous, cyl. lb.	.134-.....	.134-.....	.11-.13
Ammonium carbonate, powd. tech., casks.....lb.	.104-.14	.104-.14	.104-.14
Sulphate, wks.....cwt.	2.40-.....	2.40-.....	2.50-.....
Amylacetate tech., drums.....gal.	1.75-2.00	1.75-2.00	2.15-2.20
Antimony Oxide, bbl.....lb.	.134-.15	.134-.15	.144-.15
Arsenic, white, powd., bbl. lb.	.04-.044	.04-.044	.034-.044
Red, powd., keg.....lb.	.09-.10	.094-.10	.11-.12
Barium carbonate, bbl.....ton	48.00-50.00	48.00-50.00	47.00-50.00
Chloride, bbl.....ton	55.00-58.00	56.00-58.00	60.00-64.00
Nitrate, cask.....lb.	.08-.084	.08-.084	.074-.08
Blanc fixe, dry, bbl.....lb.	.04-.044	.04-.044	.04-.044
Bleaching powder, f.o.b., wks. drums.....cwt.	2.00-2.10	2.00-2.10	2.00-2.10
Borax, bbl.....lb.	.04-.044	.04-.044	.044-.05
Bromine, cs.....lb.	.45-.47	.45-.47	.45-.47
Calcium acetate, bags.....cwt.	3.50-.....	3.50-.....	3.50-.....
Arsenate, dr.....lb.	.064-.07	.064-.07	.064-.07
Carbide, drums.....lb.	.05-.06	.05-.06	.05-.06
Chloride, fused, dr., wks.....ton	20.00-.....	20.00-.....	21.00-.....
Phosphate, bbl.....lb.	.07-.074	.07-.074	.07-.074
Carbon bisulphide, drums.....lb.	.05-.06	.054-.06	.054-.06
Tetrachloride drums.....lb.	.064-.07	.064-.07	.064-.07
Chlorine, liquid, tanks, wks. lb.	.034-.044	.034-.044	.04-.044
Cylinders.....lb.	.054-.08	.054-.08	.054-.08
Cobalt oxide, cans.....lb.	2.10-2.20	2.10-2.20	2.10-2.25
Coppers, bag., f.o.b. wks.....ton	16.00-17.00	16.00-17.00	15.00-16.00
Copper carbonate, bbl.....lb.	.17-.174	.17-.18	.164-.17
Cyanide, tech., bbl.....lb.	.49-.50	.49-.50	.49-.50
Sulphate, bbl.....cwt.	5.05-5.10	5.05-5.10	4.90-5.00
Cream of tartar, bbl.....lb.	.254-.26	.274-.28	.22-.23
Diethylene glycol, dr.....gal.	.10-.15	.15-.20	.....
Epsom salt, dom., tech., bbl. cwt.	1.75-2.15	1.75-2.00	1.75-2.00
Imp., tech., bags.....cwt.	1.15-1.25	1.15-1.25	1.35-1.40
Ethyl acetate, 85% drums.....gal.	.74-.76	.74-.76	.74-.76
Formaldehyde, 40%, bbl.....lb.	.084-.084	.084-.114	.114-.114
Furfural, dr.....lb.	.15-.174	.15-.174	.15-.17
Fusel oil, crude, drums.....gal.	1.30-1.40	1.30-1.40	1.40-1.50
Refined, dr.....gal.	2.50-3.00	2.50-3.00	2.50-3.00
Glauber's salt, bags.....cwt.	1.10-1.20	1.00-1.10	1.20-1.40
Glycerine, e.p., drums, extra. lb.	.17-.18	.19-.20	.27-.....
Lead:			
White, basic carbonate, dry, casks.....lb.	.084-.....	.084-.....	.094-.....
White, basic sulphate, csk. lb.	.074-.....	.074-.....	.094-.....
Red, dry, csk.....lb.	.094-.....	.10-.....	.104-.....
Lead acetate, white crys., bbl. lb.	.13-.134	.13-.134	.144-.....
Lead arsenate, powd., bbl. lb.	.12-.13	.12-.13	.14-.15
Lime, chem., bulk.....ton	8.50-.....	8.50-.....	8.50-.....
Litharge, powd., csk.....lb.	.084-.....	.09-.....	.104-.....
Lithopone, bags.....lb.	.054-.06	.054-.06	.054-.064
Magnesium carb., tech., bags. lb.	.074-.08	.074-.08	.074-.08
Methanol, 95%, dr.....gal.	.43-.....	.48-.....	.85-.....
97%, dr.....gal.	.45-.....	.50-.....	.52-.....
Nickel salt, double, bbl.....lb.	.10-.....	.10-.....	.10-.....
Single, bbl.....lb.	.104-.....	.104-.....	.104-.....

	Current Price	Last Month	Last Year
Orange mineral, csk.....lb.	\$0.114-.....	\$0.12-.....	\$0.13-.....
Phosphorus, red, casks.....lb.	.62-\$0.65	.62-\$0.65	.62-\$0.65
Yellow, cases.....lb.	.32-.33	.32-.34	.32-.33
Potassium bichromate, casks. lb.	.084-.084	.084-.084	.084-.084
Carbonate, 80-85%, calc., csk. lb.	.054-.06	.054-.06	.054-.06
Chlorate, powd.....lb.	.084-.09	.084-.09	.084-.09
Cyanide, cs.....lb.	.55-.57	.55-.58	.55-.57
First sort, csk.....lb.	.09-.094	.084-.09	.084-.09
Hydrozide (c'atic potash) dr. lb.	.074-.074	.074-.074	.074-.074
Muriate, 80% bag.....ton	36.40-.....	36.40-.....	36.40-.....
Nitrate, bbl.....lb.	.06-.064	.06-.064	.06-.074
Permanganate, drums.....lb.	.15-.16	.14-.15	.144-.15
Prussiate, yellow, casks.....lb.	.18-.19	.18-.19	.18-.19
Salt ammonia, white, casks. lb.	.047-.05	.047-.05	.054-.06
Salsoda, bbl.....cwt.	.90-.95	.90-.95	.90-.95
Salt cake, bulk.....ton	17.00-18.00	17.00-18.00	17.00-19.00
Soda ash, light, 58%, bags, contract.....cwt.	1.32-.....	1.324-.....	1.324-.....
Dense, bags.....cwt.	1.35-.....	1.374-1.55	1.374-.....
Soda, caustic, 76%, solid, drums, contract.....cwt.	2.80-3.00	2.80-3.00	3.00-.....
Acetate, works, bbl.....lb.	.044-.054	.044-.05	.044-.05
Bicarbonate, bbl.....cwt.	2.00-2.25	2.00-2.25	2.00-2.25
Bichromate, casks.....lb.	.064-.064	.064-.064	.064-.064
Bisulphate, bulk.....ton	3.00-3.50	5.00-5.50	5.00-5.50
Bisulphite, bbl.....lb.	.034-.04	.034-.04	.034-.04
Chlorate, keg.....lb.	.054-.06	.064-.064	.064-.064
Chloride, tech.....ton	12.00-14.75	12.00-14.75	12.00-14.00
Cyanide, casks, dom.....lb.	.18-.22	.18-.22	.19-.22
Fluoride, bbl.....lb.	.09-.094	.084-.09	.094-.10
Hyposulphite, bbl.....cwt.	2.50-3.00	2.50-3.00	2.50-3.00
Nitrate, bags.....cwt.	2.35-.....	2.35-.....	2.63-.....
Nitrite, casks.....lb.	.074-.08	.074-.08	.084-.09
Phosphate, dibasic, bbl. lb.	.03-.034	.034-.034	.034-.034
Prussiate, yel. drums.....lb.	.114-.12	.12-.124	.11-.114
Silicate (30% drums).....cwt.	.75-1.15	.75-1.15	.75-1.15
Sulphide, fused, 60-62%, dr. lb.	.034-.04	.034-.04	.024-.03
Sulphite, crys., bbl.....lb.	.034-.034	.034-.034	.024-.03
Strontium nitrate, bbl.....lb.	.09-.094	.084-.09	.084-.09
Sulphur, crude at mine, bulk. ton	18.00-.....	18.00-.....	18.00-.....
Chloride, dr.....lb.	.04-.05	.04-.05	.05-.054
Dioxide, cyl.....lb.	.09-.10	.09-.10	.09-.10
Flour, bag.....cwt.	2.70-3.00	2.70-3.00	2.70-3.00
Fin bichloride, bbl.....lb.	.154-.....	.164-.....	.20-.....
Oxide, bbl.....lb.	.57-.....	.60-.....	.70-.....
Crystals, bbl.....lb.	.384-.....	.40-.....	.474-.....
Zinc chloride, gran., bbl.....lb.	.064-.064	.064-.064	.064-.064
Carbonate, bbl.....lb.	.10-.11	.10-.104	.104-.11
Cyanide, dr.....lb.	.40-.41	.40-.41	.40-.41
Dust, bbl.....lb.	.09-.10	.104-.11	.09-.10
Zinc oxide, lead free, bag. lb.	.064-.....	.064-.....	.064-.....
5% lead sulphate, bags.....lb.	.064-.....	.064-.....	.064-.....
Sulphate, bbl.....cwt.	2.75-3.00	2.75-3.00	2.75-3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.....lb.	\$0.134-\$0.14	\$0.13-\$0.134	\$0.134-\$0.14
Chinawood oil, bbl.....lb.	.17-.....	.17-.....	.30-.....
Coconut oil, Ceylon, tanks, N. Y.....lb.	.084-.....	.084-.....	.084-.....
Corn oil crude, tanks, (f.o.b. mill).....lb.	.084-.....	.094-.....	.084-.....
Cottonseed oil, crude (f.o.b. mill), tanks.....lb.	.074-.....	.074-.....	.074-.....
Linseed oil, raw, ear lots, bbl. lb.	.098-.....	.098-.....	10.3-.....
Palm, Lagos, casks.....lb.	.074-.....	.074-.....	.084-.....
Niger, casks.....lb.	.074-.....	.074-.074	.08-.....
Palm Kernel, bbl.....lb.	.094-.....	.094-.....	.09-.....
Peanut oil, crude, tanks (mill) lb.	.094-.....	.094-.....	.124-.....
Perilla, bbl.....lb.	.....	.....	.....
Rapeseed oil, refined, bbl. gal.	.85-.86	.86-.87	.82-.84
Sesame, bbl.....lb.	.....	.....	.....
Soya bean tank (f.o.b. Coast) lb.	.094-.....	.094-.....	.094-.....
Sulphur (olive foots), bbl.....lb.	.094-.....	.094-.....	.094-.....
Cod, Newfoundland, bbl. gal.	.66-.67	.63-.64	.63-.65
Menhaden, light pressed, bbl. gal.	.60-.66	.60-.62	.60-.62
Crude, tanks (f.o.b. factory) gal.	.40-.....	.40-.....	.45-.....
Whale, crude, tanks.....lb.	.064-.....	.074-.....	.074-.....
Grease, yellow, loose.....lb.	.094-.....	.094-.....	.11-.....
Oleo stearine.....lb.	.094-.....	.094-.....	.104-.....
Red oil, distilled, d.p. bbl. lb.	.084-.....	.084-.....	.074-.....
Tallow, extra, loose.....lb.	.084-.....	.084-.....	.074-.....

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl. lb.	\$0.60-\$0.65	\$0.60-\$0.65	\$0.60-\$0.62
Refined, bbl.....lb.	.85-.90	.85-.90	.85-.90
Alpha-naphthylamine, bbl. lb.	.35-.36	.35-.36	.35-.36
Aniline oil, drums, extra.....lb.	.15-.16	.15-.16	.15-.16
Aniline salts, bbl.....lb.	.24-.25	.24-.25	.24-.25
Anthracene, 80%, drums.....lb.	.60-.65	.60-.65	.60-.65

Coal Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr. lb.	1.15 - 1.25	1.15 - \$1.35	1.15 - 1.25
Benzidine base, bbl. lb.	.70 - .72	.70 - .75	.70 - .72
Benzoic acid, U.S.P., kgs. lb.	.58 - .60	.58 - .60	.58 - .60
Benzyl chloride, tech, dr. lb.	.25 - .26	.25 - .26	.23 - .24
Benzol, 90%, tanks, works. . . . gal.	.21 - .22	.24 - .25	.24 - .25
Beta-naphthol, tech., drums . . . lb.	.22 - .24	.22 - .24	.22 - .24
Crenol, U.S.P., dr. lb.	.18 - .20	.18 - .20	.18 - .20
Cresylic acid, 97%, dr., wks. gal.	.73 - .75	.72 - .74	.57 - .60
Diethylaniline, dr. lb.	.58 - .60	.58 - .60	.58 - .60
Dinitrophenol, bbl. lb.	.31 - .35	.31 - .33	.31 - .35
Dinitrotoluene, bbl. lb.	.17 - .18	.17 - .18	.17 - .18
Dip oil, 25% dr. gal.	.28 - .30	.28 - .30	.28 - .30
Diphenylamine, bbl. lb.	.45 - .47	.45 - .47	.45 - .47
H-acid, bbl. lb.	.63 - .65	.63 - .65	.63 - .65
Naphthalene, flake, bbl. lb.	.044 - .05	.044 - .05	.054 - .06
Nitrobenzene, dr. lb.	.084 - .10	.09 - .10	.09 - .10
Para-nitraniline, bbl. lb.	0.52 - 0.53	0.52 - 0.53	0.50 - 0.53
Para-nitrotoluene, bbl. lb.	.28 - .32	.28 - .32	.40 - .42
Phenol, U.S.P., drums. lb.	.17 - .18	.18 - .19	.17 - .18
Picric acid, bbl. lb.	.30 - .40	.30 - .40	.25 - .26
Pyridine, dr. lb.	3.00 - . . .	3.00 - . . .	3.90 - 4.00
R-salt, bbl. lb.	.47 - .50	.47 - .50	.47 - .50
Resorcinol, tech, kgs. lb.	1.30 - 1.35	1.35 - 1.40	1.30 - 1.40
Salicylic acid, tech., bbl. lb.	.30 - .32	.30 - .32	.30 - .32
Solvent naphtha, w.w., tanks. gal.	.35 - . . .	.35 - . . .	.35 - . . .
Tolidine, bbl. lb.	.95 - .95	.95 - .96	.90 - .95
Toluene, tanks, works. gal.	.35 - . . .	.35 - . . .	.35 - . . .
Xylene, com., tanks. gal.	.36 - .41	.36 - .41	.36 - .40

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl. ton	\$23.00-\$25.00	\$23.00-\$25.00	\$23.00-\$25.00
Cassia, tech., bbl. lb.	.16 - .18	.17 - .18	.15 - .16
China clay, dom., f.o.b. mine ton	10.00 - 20.00	10.00 - 20.00	10.00 - 20.00
Dry colors:			
Carbon gas, black (wks.) lb.	.064 - .07	.064 - .07	.08 - .084
Prussian blue, bbl. lb.	.31 - .33	.31 - .33	.33 - .34
Ultramarine blue, bbl. lb.	.08 - .35	.08 - .35	.08 - .35
Chrome green, bbl. lb.	.27 - .31	.27 - .30	.27 - .30
Carmine red, tina. lb.	5.50 - 5.75	5.50 - 5.75	5.00 - 5.10
Para toner. lb.	.70 - .80	.70 - .80	.80 - .90
Vermilion, English, bbl. lb.	1.80 - 1.85	1.80 - 1.85	1.45 - 1.50
Chrome yellow, C. P., bbl. . . . lb.	.17 - .18	.17 - .18	.174 - .18
Feldspar, No. 1 (f.o.b. N. C.) ton	5.75 - 7.00	5.75 - 7.00	6.00 - 6.50
Graphite, Ceylon, lump, bbl. . . lb.	.074 - .08	.074 - .094	.08 - .09
Gum copal, Congo, bags. lb.	.074 - .08	.074 - .08	.094 - .10
Manila, bags. lb.	.15 - .18	.15 - .16	.15 - .18
Damar, Batavia, cnaes. lb.	.23 - .24	.23 - .24	.25 - .25
Kauri, No. 1 cnaes. lb.	.48 - .53	.48 - .53	.55 - .57
Kieselguhr (f.o.b. N. Y.) ton	50.00 - 55.00	50.00 - 55.00	50.00 - 55.00
Magnesite, calc. ton	44.00 - . . .	44.00 - . . .	44.00 - . . .
Pumice stone, lump, bbl. lb.	.05 - .07	.05 - .08	.05 - .07
Imported, cnaes. lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H. bbl.	9.75 - . . .	9.75 - . . .	11.62 - . . .
Turpentine. gal.	.60 - . . .	.60 - . . .	.77 - . . .
Shellac, orange, fine, bags. . . lb.	.51 - .52	.59 - .61	.49 - .51
Bleached, bonedry, bags. . . lb.	.54 - .56	.61 - .63	.53 - .55
T. N. bags. lb.	.44 - .45	.55 - .57	.44 - .46
Soapstone (f.o.b. Vt.), bags. ton	10.00 - 12.00	10.00 - 12.00	10.00 - 12.00
Talc, 200 mesh (f.o.b. Vt.) . . . ton	10.50 - . . .	10.50 - . . .	11.00 - . . .
200 mesh (f.o.b. Ga.) ton	7.50 - 10.00	7.50 - 10.00	7.50 - 11.00
325 mesh (f.o.b. N. Y.) ton	13.75 - . . .	13.75 - . . .	14.75 - . . .

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl. lb.	\$0.234 - \$0.24	\$0.234 - \$0.26	\$0.25 - \$0.26
Beeswax, ref., light. lb.	.43 - .45	.43 - .47	.45 - .46
Candelilla, bags. lb.	.25 - .27	.25 - .27	.33 - .34
Carnauba, No. 1, bags. lb.	.54 - .55	.54 - .55	.65 - .70
Paraffine, crude 105-110 m.p. lb.	.044 - .05	.044 - .05	.054 - .06

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18% ton	\$200.00 - . . .	\$200.00 - . . .	\$200.00 - . . .
Ferromanganese, 78-82% ton	100.00 - . . .	100.00 - . . .	100.00 - 90.00
Spiegeleisen, 19-21% ton	31.00 - 32.00	30.00 - 31.00	36.00 - 37.00
Ferrosilicon, 70-12% ton	33.00 - 38.00	33.00 - 38.00	33.00 - 38.00
Ferrotungsten, 70-80% lb.	.90 - .95	.95 - 1.00	1.05 - 1.10
Ferro-uranium, 35-50% lb.	4.50 - . . .	4.50 - . . .	4.50 - . . .
Ferrovanadium, 30-40% lb.	3.15 - 3.75	3.15 - 4.00	3.15 - 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic. lb.	\$0.144 - . . .	\$0.134 - . . .	\$0.134 - . . .
Aluminum, 96-99% lb.	.24 - .26	.25 - .26	.26 - .27
Antimony, Chin. and Jap. . . . lb.	.104 - .11	.104 - .11	.144 - . . .
Nickel, 99% lb.	.35 - . . .	.35 - . . .	.35 - . . .
Monel metal, blocks. lb.	.32 - .33	.32 - .33	.32 - .33
Tin, 5-ton lots, Straits. lb.	.514 - . . .	.524 - . . .	.694 - . . .
Lead, New York, spot. lb.	6.00 - . . .	6.30 - . . .	7.65 - . . .
Zinc, New York, spot. lb.	6.00 - . . .	6.00 - . . .	7.10 - . . .
Silver, commercial. oz.	.574 - . . .	.574 - . . .	.564 - . . .
Cadmium. lb.	.60 - . . .	.60 - . . .	.60 - . . .
Bismuth, ton lots. lb.	1.85 - 2.10	1.85 - 2.00	2.70 - 2.75
Cobalt. lb.	2.50 - . . .	2.50 - . . .	2.50 - . . .
Magnesium, ingots, 99% lb.	.75 - .80	.75 - .80	.75 - .80
Platinum, ref. oz.	85.00 - . . .	85.00 - . . .	108.00 - . . .
Palladium, ref. oz.	50.00 - 52.00	50.00 - 52.00	68.00 - 70.00
Mercury, flask. 75 lb.	120.50 - . . .	121.00 - . . .	104.00 - . . .
Tungsten powder. lb.	1.05 - 1.15	1.05 - . . .	1.10 - . . .

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks. ton	\$5.50 - \$8.50	\$5.50 - \$8.50	\$5.50 - \$8.75
Chrome ore, c.f. post. ton	22.00 - 24.00	22.00 - 24.00	22.00 - 23.00
Coke, fdry., f.o.b. ovens. ton	2.85 - 3.00	2.85 - 3.00	3.75 - 4.25
Fluorspar, gravel, f.o.b. Ill. . . . ton	14.50 - . . .	17.00 - . . .	18.00 - . . .
Ilmenite, 52% TiO ₂ , Va. lb.	.004 - .004	.004 - .004	.014 - . . .
Manganese ore, 50% Mn., c.i.f. Atlantic Ports. unit	.36 - .38	.36 - .38	.36 - .38
Molybdenite, 85% MoS ₂ per lb. MoS ₂ , N. Y. lb.	.48 - .50	.48 - .50	.48 - .50
Monasite, 6% of ThO ₂ ton	120.00 - . . .	120.00 - . . .	120.00 - . . .
Pyrites, Span. fines, c.i.f. unit	.134 - . . .	.134 - . . .	.134 - . . .
Rutile, 94-96% TiO ₂ lb.	.11 - .13	.11 - .13	.11 - .13
Tungsten, scheelite, 60% WO ₃ and over. unit	10.50 - 10.75	10.50 - 10.75	11.25 - 11.50
Vanadium ore, per lb. V ₂ O ₅ . . . lb.	.25 - .28	.25 - .30	.25 - .28
Zircon, 99% lb.	.03 - . . .	.03 - . . .	.03 - . . .

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Bronze Powder Factory—Aluminum Bronze Powder Co., c/o P. J. Steigerwald, 1823 Columbus Rd., Cleveland, O., plans a 1 story, 40 x 80 ft. bronze powder factory. Estimated cost \$40,000. Private plans.

Burner Building, etc.—The Grasselli Chemical Co., Guardian Bldg., Cleveland, O., had plans prepared for a 1 story, 22 x 66 ft. burner building and 37 x 61 ft. power plant on Independence Rd. Estimated cost \$40,000. Private plans.

Alum and Recarbonating Plant, etc.—City of Grand Rapids, Mich., plans election in March to vote \$1,800,000 bonds for waterworks improvements to include additional space for alum lime feeding devices, alum and recarbonating plant, alum and lime storage, etc. R. E. Harrison, City Hall, Grand Rapids, Mich., is consulting engineer.

Aluminum Factory—Club Aluminum Co., c/o R. E. Lee, Dist. Mgr., Fitzpatrick Bldg., Portland, Ore., will build an aluminum factory. Estimated cost \$50,000 to \$100,000.

By-Products Plant—Koppers Co., Waterfront St., New Haven, Conn., awarded contract for a 1 and 2 story, 98 x 124 ft. by-products plant, to Koppers Erection Co., Waterfront St., New Haven. Estimated cost \$100,000.

Calcium Chloride, Road Oil, etc.—Hennepin County, Minneapolis, Minn., A. P. Erickson, Auditor, will receive bids for calcium chloride for road use, for 1928 season.

Canning Plant Equipment—Otterville Cannery Ltd., F. Quinn, Mgr., Otterville, Ont., plans the installation of canning plant equipment for handling corn, peas, tomatoes and beans, estimated cost \$10,000.

Carbide and Carbon Plant—Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., is having preliminary plans prepared for a 1 story carbide and carbon plant at Thomas and Foste Sts., Shreveport, La. Estimated cost \$150,000.

Carbon Black Plant—M. A. Coogan, Holdenville, Okla., plans the construction of a natural gas carbon black plant. Estimated cost \$350,000. Private plans.

Cement Plant—Monolith Portland Cement Co., Bartlett Bldg., Los Angeles, Calif., plans extensions and improvements to cement plant at Bakersfield, Calif. Estimated cost \$350,000.

Carbon and Ribbon Factory—Canadian Carbon & Ribbon Co., 73 Adelaide St. W., Toronto, Ont., plans the construction of a 3 story carbon and ribbon factory on King St. W. Estimated cost \$60,000. Architect not selected.

Cement Plant—Missouri Portland Cement Co., Southwestern Bell Telephone Bldg., St. Louis, Mo., awarded contract for a 40 x 400 ft. kiln building including three batteries of silos conjoined, etc., for cement plant on Prospect Hill to Gamble Construction Co., 620 Chestnut St., St. Louis, Mo. Estimated cost including equipment \$2,000,000.

Chemical Plant—Dept. of Highways and Public Works, Nashville, Tenn., awarded contract for the construction of a chemical plant for Victor Chemical Co., Centennial Blvd., to Foster & Creighton Co., Fourth and First National Bank Bldg., Nashville, Tenn. Estimated cost \$50,000.

Chemical Plant Addition—Monsanto Chemical Co., 1800 South Second St., St. Louis, Mo., awarded contract for a 2 story, 53 x 53 ft. addition to chemical plant on Falling Spring Rd., St. Clair county, south of East St. Louis, Ill., to J. I. Gedney, 1461 Hall St., East St. Louis, Ill. Estimated cost \$25,000.

Chemistry Building—Bd. of Trustees, Ohio State University, C. E. Steele, Secy., Columbus, O., awarded contract for a 5 story, 84 x 150 ft. addition to chemistry building to Van Gundy Beck & Co., Lancaster, O. Estimated cost \$196,000.

Chemistry Building—Howard University, 2401 6th St. N. W., Washington, D. C., plans the construction of a chemistry building. Estimated cost \$260,000. A. I. Cassell, c/o owner, is architect.

Chemical Factory—Merrimac Chemical Co., 148 State St., Boston, Mass., will build a 40 x 60 ft. chemical factory at North Woburn, Mass., by day labor.

Chlorine Manufacturing Equipment—Canadian Salt Co., G. Duck, Gen. Mgr., Sandwich, Ont., prices and catalogs on chlorine manufacturing equipment, etc., for plant recently destroyed by fire.

Compounding Building—Vacuum Oil Co., Paulsboro, N. J., awarded contract for a 1 story, 50 x 100 ft. compounding building to White Construction Co., Jefferson Bldg., Philadelphia, Pa.

Cork Finishing Building and Warehouse—Armstrong Cork Co., Codruse Ave., New Brunswick, N. J., awarded contract for a 1 story, 120 x 175 ft. cork finishing building and warehouse, to G. D. Rule Inc., 71 John St., New Brunswick, N. J. Estimated cost \$150,000.

Cork and Seal Plant—Crown Cork & Seal Co., 87 Parliament St., Toronto, Ont., awarded contract for a 1 story, 120 x 120 ft. cork and seal plant on Carlaw Ave. to Wells & Gray Ltd., Confederation Life Bldg., Toronto, Ont. Estimated cost \$100,000.

Cotton Oil Mill—Tullis Cotton Oil Investment Co., Central Trust Bldg., San Antonio, Tex., plans the construction of a cotton oil mill in South Texas. Estimated cost \$500,000. Plants will be erected from time to time until six are completed. Machinery and equipment will be required.

Curing and Canning Plant—V. F. Marek, Cement, Okla., is having preliminary plans prepared for a 1 story sweet potato curing and canning plant. Estimated cost \$60,000. Architect not selected. Drying and canning equipment will be required.

Dry Kilns—The Hydraulic Press Brick Co., Central National Bank Bldg., St. Louis, Mo., is having plans prepared for the construction of two kilns, 50 ft. long, 6 ft. in diameter, at Cleveland, O. K. H. Mitten-dorf, 506 Interstate Bldg., Kansas City, Mo., is engineer.

Enameling Plant—Fostoria Pressed Steel Co., R. C. Carter, Pres., Fostoria, O., will soon receive bids for a 1 story enameling plant. Forster & Wernert, 1620 Nicholas Bldg., Toledo, O., are architects.

Fertilizer Plant—Bowker Chemical Co., Canton, Baltimore, Md., subsidiary of American Agricultural Chemical Co., 420 Lexington Ave., New York, N. Y., plans to rebuild portions of fertilizer plant recently destroyed by fire.

Fuel Plant—Atomized Fuel Corp., Fort Dodge, Ia., will receive bids about Apr. 10 for a 1 story, 35 x 126 ft. fuel plant. Estimated cost \$80,000. Pennsylvania Engineering Co., New Castle, Pa., is engineer.

Gas Plant—City, R. L. Albright, Clk., Cedar Falls, Ia., plans an election Mar. 19, to vote \$150,000 bonds for the construction of a gas plant.

Gasoline Plant—Roxanna Petroleum Co., Mayo Bldg., Tulsa, Okla., is having preliminary plans prepared for a natural gasoline plant, 60,000 gal. daily capacity near Marshall, Okla. Estimated cost \$100,000. Private plans.

Glass Plant—Capital Glass & Mirror Co., 714 West Baltimore St., Baltimore, Md., will build a 1 story addition to glass plant.

Glass Plant—Fostoria Glass Co., Moundsville, W. Va., awarded contract for a 2 and 3 story, 75 x 260 ft. addition to glass plant to R. R. Kitchen Co., 37 19th St., Wheeling, W. Va. Estimated cost \$100,000.

Glass Plant—Pittsburgh Plate Glass Co., Frick Bldg., Pittsburgh, Pa., plans the construction of a glass plant at Richmond, Calif. Estimated cost \$5,000,000.

Glass Plant—Pittsburgh Safety Glass Co., c/o A. B. McClure, Pittsburgh Plate Glass Co., Creighton, Pa., is having preliminary plans prepared for a 1 story glass plant. Estimated cost \$40,000. Private plans.

Glass Plant—Van Sickle Glass & Paint Co., W. Van Sickle, Pres., 138 South 10th St., Lincoln, Neb., is having plans prepared for a 2 story glass plant at 3rd and M Sts. Meginnis & Schaumburg, Federal Trust Bldg., Lincoln, Neb., Architects.

Glass Plant Addition—The Capstan Glass Co., Connellsville, Pa., awarded contract for a 1 story, 100 x 180 ft. addition to glass plant, to Connellsville Iron Works, Connellsville, Pa. Estimated cost \$40,000.

Gum Factory—O-Pee-Chee Gum Co., J. K. MacDermid, Mgr., London, Ont., awarded contract for a 4 story, 85 x 125 ft. gum factory on Adelaide St., to J. A. McDonald, Alisa Craig, Ont. Estimated cost \$100,000. Special equipment for the manufacture of gum, paper boxes, etc., will be installed.

Honey Plant—Southwest Honey Producing Syndicate Inc., 1423 West 11th St., Los Angeles, Calif., awarded contract for a 1 story, 100 x 240 ft. honey plant. Estimated cost \$140,000. Travers & Jacobs, 11 Federal Trust & Savings Bldg., are architects.

Hot Mill—Timken Roller Bearing Co., Canton, O., awarded contract for a 100 x 285, 100 x 365, 80 x 135 and 135 x 252 ft. additions to hot mill, to Warren G. Hoff-

man Co., Witters Bldg., Canton, O. Estimated cost \$200,000.

Ink Factory—G. Vogl, 5519 Harrison St., Kansas City, Mo., awarded contract for a 2 story, 51 x 107 ft. ink factory at 2615 Southwestern Blvd. to J. E. Dunn, Reliance Bldg. Estimated cost \$45,000. D. Foe & Besocke, 114 West 10th St., Kansas City, Mo., are architects.

Laboratory (Chemistry)—Amherst College, M. Thatcher, Chn. Bldg. Committee, Amherst, Mass., is having preliminary plans prepared for a chemistry laboratory. Estimated cost \$300,000. McKim, Meade & White, 101 Park Ave., New York, N. Y., are architects.

Laboratory (Chemistry)—Ed. of Trustees, Ohio State University, C. E. Steele, Secy., Columbus, O., is having plans prepared for a 3 story addition to chemistry building. Estimated cost \$350,000. J. N. Bradford, c/o owner, is architect.

Laboratory (Chemistry)—Case School of Applied Science, C. S. Howe, Pres., Euclid Ave., Cleveland, O., plans the construction of a 3 story chemistry laboratory. Estimated cost \$250,000. Wilbur Watson & Associates, 4614 Prospect St., are architects and engineers.

Laboratory (Pathological)—University of Toronto, Queens Park, Toronto, Ont., is having plans prepared for 5 or 6 story laboratories. Estimated cost \$500,000. Darling & Pearson, 2 Leader Lane, Toronto, Ont., are architects.

Laboratory (Research)—Cleveland Clinic Hospital, 8803 Euclid Ave., Cleveland, O., will soon award contract for an 8 story, 34 x 74 ft. research laboratory on East 90th St. Estimated cost \$300,000. Ellerbe & Co., 692 Endicott Bldg., St. Paul, Minn., are architects.

Laboratories—National Research Council, Ottawa, will soon receive bids for laboratories, etc., on Luxsex St. Estimated cost \$1,000,000.

Laboratories, Etc.—Anso Photoproducts Co., Binghamton, N. Y., plans the construction of a factory including laboratories, etc. Estimated cost \$1,000,000. O. S. Schlich, 136 Liberty St., New York, N. Y., is architect and engineer.

Laboratories (Chemistry and Physics)—University of California, A. Underhill, Comptroller, 855 North Vermont Ave., Los Angeles, Calif., awarded contract for a 3 story, 125 x 181 ft. chemistry laboratory and 3 story, 129 x 218 ft. physics laboratory near Westwood, Calif., to Pozzo Construction Co., 421 Macy St., Los Angeles, Calif. Estimated cost \$638,875.

Lumber and Creosoting Plant—Creosoting Co., 312 Railway Exchange Bldg., Kansas City, Mo., told plans lumber and creosoting plant first unit capable of handling 6,000 cars of lumber per year at Wilmington, Del. Estimated cost \$1,000,000.

Mineral Developments—American Metal Co., Ltd., Mills Rd., El Paso, Tex., have acquired the Presidio mines at Shafter, Tex., and plans to enlarge operations, install machinery and equipment and other improvements on 1,200 acre site. Estimated cost \$75,000. Private plans.

Milk Evaporating Plant—Borden Farm Products Co., Inc., 110 Hudson St., New York, N. Y., awarded contract for a 2 story, 114 x 312 ft. milk evaporating plant at Macon, Miss., to H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O. Estimated cost \$125,000.

Milk Machinery—E. Hernandez, Av. Madero 553, Guadalajara, Mexico, prices and catalogs on machinery and equipment for the manufacture of vegetable oils.

Oil Reclaiming Plant—New Zealand Government Railways, Wellington, N. Z., will receive bids until June 25, for an oil reclaiming plant, etc.

Varnish Factory—Michaelson & Rognstad, 3256 Franklin Blvd., Chicago, Ill., Architects, are receiving bids for a 3 story varnish factory at 5th Ave. and Kolmar St. for Elliott Varnish Co., 4525 West 5th Ave., Chicago, Ill. Estimated cost \$75,000.

Oxygen Plant—Western Oxygen Co., 2421 East 58th St., Los Angeles, Calif., awarded contract for an oxygen plant on Second St., Sacramento, Calif., to Campbell Construction Co., 800 R. St., Sacramento, Calif. Estimated cost \$100,000.

Oxygen Producing and Tanking Plant—Western Oxygen Co., 2421 West 58th St., Los Angeles, Calif., awarded contract for a 1 story, 100 x 100 ft. oxygen plant at Sacramento, Calif., to Campbell Construction Co., 800 R. St., Sacramento. Estimated cost \$100,000.

Paint Factory—J. F. Kurfees Paint Co., 201 East Market St., Louisville, Ky., awarded contract for a 4 story, 62 x 294 ft. paint factory at 201 East Market St., to A.

Markham & Co., 432 South Floyd St., Louisville, Ky. Estimated cost \$150,000.

Paint Factory—Hill Hubbard Paint Co., Tulsa, Okla., is having plans prepared for a 4 story, 70 x 70 ft. paint factory at Sand Springs, Okla. Estimated cost \$70,000. W. D. Blakeley, 922 West Third St., Tulsa, Okla., is architect.

Paint and Varnish Factory—Glidden Co., 2876 Attleboro Rd., Cleveland, O., is considering erection of a new paint and varnish factory at Houston, Tex. Estimated cost including equipment \$130,000.

Paper Mill—Spanish River Pulp & Paper Co. Ltd., C. H. I. Jones, V. Pres., Sault Ste Marie, Ont., plans extensions and improvements to paper mill. Estimated cost \$500,000.

Paper Plant Equipment—MacSim Bar Paper Co., L. W. Dickinson, Purch. Agt., will expend \$500,000 for addition equipment lather to increase the capacity.

Pasteurization Plant—Ottawa Dairy Co. Ltd., 393 Somerset St., Ottawa, Ont., will soon award contract for the construction of a dairy including pasteurization plant, etc. at Hull, Que. Estimated cost \$290,000. Architect not selected.

Pottery Plant Addition—Mt. Clemens Pottery Co., 101 South Rose St., Mt. Clemens, Mich., is having plans prepared for a 1 and 2 story addition to pottery plant on South Rose St. Estimated cost \$50,000. G. L. Harvey, 211 Huron St., Port Huron, Mich., is architect. Special machinery and equipment will be required.

Pulp Mill—City of Raymond, Wash., awarded contract for the construction of a 60 ton pulp mill including cut-up mill, dry kilns, etc. to Puget Sound Bridge & Dredging Co., Portland, Ore. Estimated cost \$1,000,000.

Pulp Mill—Union Bag & Paper Co., Woolworth Bldg., New York, N. Y., awarded contract for furnishing steel for pulp mill at Tacoma, Wash. to Starr Iron & Steel Co., 435 East 11th St., Tacoma, Wash. Total estimated cost \$2,000,000.

Refinery—Amarillo Producers & Refiners Corp., W. S. Roberts, Secy., Amarillo, Tex., plans to rebuild refinery recently destroyed by fire, 1,600 bbl. daily capacity to J. D. Wrather, Box 771, Amarillo, Tex. Estimated cost \$75,000. Contractor is receiving bids on agitators, stills, box boilers, pumps, etc.

Refining Mill—Black Donald Graphite Co., R. F. Bunting, Pres., Calabogie, Ont., plans the reconstruction of a refining mill. Estimated cost \$150,000.

Refinery (Oil)—Continental Oil Co., Continental Oil Bldg., Denver, Colo., plans to rebuild oil refinery at Sapulpa, Okla., recently destroyed by fire. Estimated cost \$200,000. Private plans.

Refinery (Oil)—Louisiana Oil Refining Corp., Minden Rd., Shreveport, La., plans to rebuild portion of oil refinery recently destroyed by fire.

Refinery (Oil) and Pipe Line—Pasotex Petroleum Co., subsidiary of Standard Oil Co. of San Francisco, 225 Bush St., San Francisco, Calif., is having surveys made for the construction of an oil refinery, 10,000 bbl. daily capacity at El Paso, Tex., also an oil pipe line from Co.'s West Texas oil fields to plant, about 250 mi. Estimated cost \$750,000. Private plans.

Refinery (Oil)—Vacuum Oil Co., 61 Broadway, New York, N. Y., awarded contract for a 3 story addition to oil refinery at Paulsboro, N. J. Estimated cost \$75,000.

Silk Factory—Keene Silk Fibre Mills, Emerald St., Keene, N. H., awarded contract for a 2 story, 60 x 100 ft. addition to silk factory to G. W. Scott. Private plans.

Silk Mill—Murfreesboro—M. J. Frank & Co., 102 Madison Ave., New York, N. Y., is having surveys made for the construction of a silk mill at Murfreesboro, Tenn. Estimated cost \$500,000. Roberts & Co., Atlanta, Ga., are engineers.

Smelting and Refining Plant—American Smelting & Refining Co., Maurer St., Perth Amboy, N. J., will build a 78 x 432 ft. smelting and refining plant on State St. Estimated cost \$63,000. Private plans. Work will be done by separate contracts.

Soda Factory—H. Wheaton & Sons, 45 School St., New Bedford, Mass., plans addition to soda factory. Estimated cost \$50,000. Architect not selected.

Terra Cotta Factory—Western Terra Cotta Co., Second and Franklin Sts., Kansas City, Mo., will build a 2 story, 88 x 162 ft. terra cotta factory. Private plans.

Tile Plant—Empire Floor & Wall Tile Co., Zanesville, O., will soon receive bids for a 1 story wall and floor tile plant to replace fire loss. Estimated cost \$100,000.